Indexes

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Volume 16, Number 19 October 15, 1962

NUCLEAR SCIENCE ABSTRACTS

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TABLE OF CONTENTS

Volume 16, Number 19, October 15, 1962

Category	Page
GENERAL AND MISCELLANEOUS	3283
BIOLOGY AND MEDICINE	3286
General and Miscellaneous	3286
Biochemistry, Nutrition, and Toxicology	3288
Fallout and Ecology	3293
Radiation Effects on Living Tissues	3294
Radiation Sickness	3303
CHEMISTRY	3305
General and Miscellaneous	3305
Analytical Procedures	3305
General Inorganic and Physical Chemistry	3309
Radiation Chemistry and Radiochemistry	3325
Raw Materials and Feed Materials	3333
Separation Processes	3334
ENGINEERING AND EQUIPMENT	3338
General and Miscellaneous	3338
Heat Transfer and Fluid Flow	3340
Instrumentation	3342
Materials Testing	3349
GEOLOGY, MINERALOGY, AND METEOROLOGY	3351
HEALTH AND SAFETY	3356
INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS	3360
ISOTOPE SEPARATION	3361
MATHEMATICS AND COMPUTERS	3362
METALS, CERAMICS, AND OTHER MATERIALS	3363
General and Miscellaneous	3363
Corrosion	3365
Fabrication	3368
Properties and Structure	3370
Radiation Effects	3383
PHYSICS	3389
General and Miscellaneous	3389
Astrophysics and Cosmology	3408
Cosmic Radiation	3409
Criticality Studies	3410
Elementary Particles and Radiations	3411
Neutron Physics	3424
Nuclear Properties and Reactions	3426
Particle Accelerators	3444
Plasma Physics and Thermonuclear Processes	3447
Shielding	3451
Theoretical Physics	3451
REACTOR TECHNOLOGY	3455
General and Miscellaneous	3455
Power Reactors	3472
Production Reactors	3476
Research Reactors	3476
SPACE APPLICATIONS AND TECHNOLOGY	3478
WASTE DISPOSAL AND PROCESSING	3479
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-10
SUBJECT INDEX	INDEX-42
REPORT NUMBER INDEX	INDEX-99

Volume 16, Number 19 October 15, 1962

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

25080 (ASD-TR-61-11(Vol.I)) SOLAR CELL ARRAY OPTIMIZATION. [VOLUME I.] R. R. Addiss, A. Anchutin, R. T. Aquino, E. Hecht, H. I. Moss, P. S. Nekrasov, S. Niconienko, L. J. Petti, M. Ritter, and R. R. Scott (Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.). Mar. 1961. Contract AF 33(616)-7415. 149p. (AD-270131)

Preliminary specifications are given for two optimized solar-cell-array systems. The primary optimization criterion applied was to obtain the maximum electrical power conversion of solar energy in space per unit of system weight, consistent with required minimum reliability and maximum permissible packaged volume. Specific areas considered are, photovoltaic materials, crystal conversion, solar cell circuit simulation, array interconnection optimization, adhesives, array structures, foam inflation, thermal design, temperature and intensity effects, and launch environment. (auth)

25081 (CRIO-1091) PERT. Program Evaluation and Review Technique as Applied by Atomic Energy of Canada Limited, Chalk River, Ontario. R. E. Kerr (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1962. 36p. (AECL-1536)

The PERT approach to project scheduling is developed by comparison with the conventional (bar chart) scheduling procedure. PERT terms such as expected time, slack time, and latest time are defined. The application of PERT to NRU reactor maintenance is described. (auth)

25082 (DPR/INF/267) NUCLEAR POWER IN BRITAIN, 1962. Roger Makins (United Kingdom Atomic Energy Authority, London). Apr. 1962. 9p.

The status of nuclear power in Great Britain is reviewed. Development and economic problems in the nuclear industry are discussed along with the reactor program. It is noted that the nuclear power program is based on CO_2-cooled systems using Mg alloy clad metallic natural U fuel (Magnox). Seven magnox stations are under construction, and two are authorized. Other systems are discussed including the Advanced Gas-Cooled Reactor, the Fast Reactor, and H-moderated systems. (J.R.D.)

25083 (HMI-B-22) FUNFTER JAHRESBERICHT (1961). (Fifth Annual Report (1961)). (Hahn-Meitner-Institut für Kernforschung, Berlin). May 1962. 119p.

Research progress on nuclear chemistry and mathematics is reported. (M.C.G.)

25084 (JAERI-7020) ANNUAL REPORT OF THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE FOR THE FISCAL YEAR ENDING APRIL 1961. (Japan Atomic Energy Research Inst., Tokyo). 138p.

The annual report describes the activities of the Institute in 14 chapters: reactor development, plant construction, operation of research reactors, nuclear engineering, physics, chemistry, uses of radiation, health physics, etc. JRR-2, a CP-5 type reactor which reached criticality in October 1960 is discussed; this reactor started operating at a power of 1 Mw in March 1961. The contract of JPDR (Japan Power Demonstration Reactor) was signed in August 1960; it is designed for a maximum electric output of 12.5 Mw. Assembly of graphite in JRR-3, the first Japanese-built reactor with a power rating of 10 Mw, was recently completed. Continuing the efforts in the field of reactor development, a semi-homogeneous critical assembly became critical, an aqueous homogeneous critical assembly is almost ready for fuel loading and preliminary experiments were carried out on a fast reactor and on magnetohydrodynamic methods of electric power generation. Construction of a 20-Mev linear accelerator was completed; in addition, a 5.5-Mev Van de Graaff generator, a hot-cave unit for fuel reprocessing work, a plutonium research facility and a radioisotope production plant are under construction at present. (TTT)

25085 (JAERI-7022) PROCEEDINGS OF THE THIRD LECTURE MEETING ON RESEARCH ACHIEVEMENTS OF THE JAPAN ATOMIC ENERGY RESEARCH INSTITUTE. (Japan Atomic Energy Research Inst., Tokyo). Nov. 1961. 73p. (In Japanese)

Several research activities of the Japan Atomic Energy Research Institute are described. The power of the CP-2 type reactor, JRR-2, was raised to 1000 kw, attaining a total power output of 370,000 kwh by August 1961. A crystal neutron diffractometer was placed in service at the time of the startup of JRR-2, studying the magnetic properties of UFe_2. Analytical methods based on emission spectroscopy, mass spectroscopy, and extraction absorption spectroscopy were developed, carrying out impurity determinations in natural U fuel, JRR-1 fuel, and in various U alloys. Problems involved in the construction of atomic energy facilities were also discussed. The research activities of the Nuclear Engineering Division, metallurgical studies on nuclear fuels and structural materials, and investigations of heat transfer properties, reactor kinetics, and fuel reprocessing are described. (TTT)

25086 (KGO-611) REPORT ON OBSERVATIONS MADE AT KIRUNA GEOPHYSICAL OBSERVATORY DURING THE SERIES OF NUCLEAR WEAPON TESTS CARRIED OUT AT NOVAJA ZEMLJA BETWEEN SEPTEMBER 10 AND NO-

VEMBER 4, 1961. B. Hultqvist, A. Egeland, G. Gustafsson, L. Liszka, J. Ortner, K. E. Heikkilae, S. Olsen, T. Maekitalo, and B. Eriksson (Sweden. Kunglica Vetenskapsakademien. Geofysiska Observatoriet, Kiruna). Dec. 11, 1961. 90p. (A/AC.82/G/L.755).

A review of previously published reports on upper atmosphere effects of nuclear explosions is given. The equipment used for taking the records at Kiruna Geophysical Observatory during the nuclear weapon test series at Novaja Zemlja between Sept. 10 and Nov. 4, 1961 is briefly described. The observations possibly associated with the blasts are reported and discussed. Virtually no electromagnetic or upper atmospheric indications on a nuclear weapon test could be found at Kiruna on the days Sept. 10, Oct. 2, 6, 8, and 25, and Nov. 2. Some indications, but of low significance, were obtained on Sept. 14, 18, 20, Oct. 4, and Nov. 4. Probable effects were recorded on Sept. 12, 16, and 22, and Oct. 20 and 27. Highly significant observations of upper atmosphere effects were made only when the very largest weapons were detonated, i.e., on Oct. 23, 30, and 31. On the basis of the Kiruna observations it seems probable that the explosion of Sept. 16, for which day no time of explosion based on seismic or other effects was known to the authors, occurred close to 0830 UT. No self consistent picture of the effects of the nuclear explosions on the upper atmosphere was possible to arrive at on the basis of the Kiruna observation, only. Possible interpretations—mostly highly speculative—of the observations on Oct. 23, 30, and 31 are discussed. (auth)

25087 (NP-11817) SURFACE BURST OF 100 TON TNT HEMISPHERICAL CHARGE GROUND DISPLACEMENT. Suffield Technical Report No. 250. G. H. S. Jones, J. Krohn, and John M. Dewey (Canada. Suffield Experimental Station, Ralston, Alberta). May 14, 1962. 25p.

Deformations observed near surface burst charges of TNT are described. The measurements of permanent and transient ground displacements in the immediate vicinity of the charge are given. These include the crater dimensions, the permanent displacement of the surface surrounding the crater and the transient displacement of the ground for a period of approximately one week after the detonation. In addition, an analysis is made of all the cratering data obtained to date at SES. It is shown that there is a significant departure of the crater diameter and depth from cube scaling, but it is suggested that the crater volume in SES soil may vary directly as the charge mass. (auth)

25088 (PA-TR-1690) TESTS OF ORDNANCE MATERIEL EXPOSED TO ATOMIC BOMB DETONATION. Report No. 1. R. C. Grass (Picatinny Arsenal, Dover, N. J.). Apr. 30, 1948. 55p.

Tests were carried out to determine if exposure to the air-burst detonation of an atomic bomb caused any changes in the characteristics of explosives contained in various ordnance material items. Items tested included shaped charges, torpedos, snake charges, TNT blocks, demolition blocks, cratering charges, and detonating cord. No significant differences were found among the explosives investigated that could be attributed to exposure to the air-burst detonation of the atomic bomb. No residual radioactivity was found on any of the items. Paper and/or cardboard containers were damaged to a degree proportional to the severity of their exposure, while metal containers were damaged little or not at all. (M.C.G.)

25089 DIRECT CONVERSION AND FUSION REACTORS. J. W. Gardner (English Electric Co. Ltd., Whetstone, Leics, Eng.). Brit. Power Eng., 5: No. 2, 24-31 (July 1962).

A review is given of properties and future prospects of direct conversion devices such as magnetohydrodynamic (MHD) cells, fuel cells, thermoelectric devices, and thermionic devices. The uses of solar, fission, and fusion energy as power sources are outlined. Particular attention is devoted to the fusion reactor, especially regarding its efficiency, working cycle, containment, stability, and energy balance. Attention is also given to such hybrid systems as the plasma reactor, and to the use of direct conversion devices in conjunction with fusion reactors. (T.F.H.)

25090 SIMULATING THE THERMAL RADIATION OF AN ATOM BOMB. H. Mahnau. Elektronische Rundschau, 15: 525-8(Nov. 1961). (In German)

An arrangement permitting simulation of thermal pulses equivalent to those of atom bomb explosions and testing their effect upon various materials is described. Experiments resulted in a simple indicator of target, target elevation, and bomb size. (auth)

25091 PROBLEMS AND ACHIEVEMENTS OF THE HUNGARIAN SCIENCE IN THE FIELD OF SPECTROSCOPY. Adam Bartecki. Wiadomości Chem., 16: 285-98 (1962). (In Polish)

Problems and achievements of Hungarian scientists in the field of spectroscopy, including spectroscopy of diatomic molecules, π-electron systems, and inorganic complexes are described. 109 references are included. (R.V.J.)

25092 SYMPOSIUM ON TRITIUM IN TRACER APPLICATIONS, NEW YORK CITY, NOVEMBER 22, 1957. Boston, New England Nuclear Corp., 1958. 43p.

Ten papers are given based on talks presented at the Symposium on Tritium in Tracer Applications. Topics covered include: gas exposure technique for tritium-labeling, tritium labeling by other methods, liquid scintillation counting of tritium, gas counting of tritium, health physics considerations, some uses of tritium-labeled compounds in pharmaceutical research, use of radioisotopes in reservoir engineering, tritium in biochemical studies, and autoradiography with tritium. (M.C.G.)

25093 PROCEEDINGS OF THE SYMPOSIUM ON ADVANCES IN TRACER APPLICATIONS OF TRITIUM, NEW YORK CITY, OCTOBER 31, 1958. Boston, New England Nuclear Corp., 1959. 69p.

Eleven papers presented at the Symposium on Advances in Tracer Applications of Tritium are given. Topics covered include: experiences with tritiated compounds prepared by exposure to tritium gas, reaction of unsaturated organic compounds with tritium gas, application of tritium to the assay of steroids in biological extracts, metabolism of DL-epinephrine-7-H^3 O-bitartrate, special features of tritium as a tracer in industrial research, application of tritium in the determination of Gibberellins, some uses of tritium in autoradiography, liquid scintillation counting of tritium in suspended materials, a new technique for counting aqueous solutions in the liquid scintillation spectrometer, tritium measurement using ionization chambers, and vapor phase proportional counting. (M.C.G.)

25094 PROCEEDINGS OF THE LUNAR AND PLANETARY EXPLORATION COLLOQUIUM HELD AT BURBANK, CALIFORNIA, ON 28 AND 29 NOVEMBER 1961. VOLUME III. NUMBER 1. E. M. Fallone, ed. Downey, California, North American Aviation, Inc., 1962. 90p.

Discussions are presented on planetary atmospheres, solar phenomena, the atmosphere of the moon, and problems of lunar and planetary exploration. (D.E.B.)

25095 UNCONVENTIONAL POWER SOURCES. OTS Selective Bibliography. (Office of Technical Services. Washington, D. C.). Feb. 1962. 19p. (SB-484).

References (426) are given to reports, books, and translations published from 1942 to August 1961. (P.C.H.)

BIOLOGY AND MEDICINE

General and Miscellaneous

25096 (TID-15980) FRACTIONATION OF THE CELLULAR ELEMENTS OF BONE MARROW AND OTHER HEMATOPOIETIC TISSUES IN AN ATTEMPT TO AVOID HOMOLOGOUS DISEASE AND AID THE ACCEPTANCE OF HOMOLOGOUS TISSUE GRAFTS. Progress Report. ([Jefferson Medical Coll., Philadelphia]). Aug. 25, 1962. Contract AT(30-1)-2862. 8p.

Progress is reported in a study of procedures for the fractionation of the cellular elements of bone marrow and other hematopoietic tissues in an attempt to avoid homologous disease and aid the acceptance of homologous tissue grafts. Preliminary experiments in mice using a slow freezing of cells in a glycerol medium suggested that a large number of cells capable of producing tetanus antitoxin were destroyed upon rapid thawing and injection into lethally irradiated isologous mice. Experimental results suggest that the functional capacity of donor marrow to engage in antitoxin production varies with the genetic differences between donor and host. (C.H.)

25097 (TID-16081) ANNUAL PROGRESS REPORT [ON TUMOR LOCALIZATION AND ORGAN VISUALIZATION STUDIES], JUNE 1, 1961 TO JUNE 1, 1962. (Roswell Park Memorial Inst., Buffalo). Contract AT(30-1)-2455. 23p.

Design features are described for an autofluoroscope scintillation detector for use in tumor localization and organ visualization studies following the administration of radioisotopes. The autofluoroscope was also used for the visualization and quantitative evaluation of a variety of dynamic processes. Fluorine-18 was used for the detection of early bone metastases, Ba^{137} was used as a tracer in a variety of investigations of the cardiovascular system, and Se^{75}-selenomethionine was used for the visualization of the pancreas in patients with disorders of the pancreas. (C.H.)

25098 SCINTILLATION SCANNING OF THE LIVER. I. PHYSICAL BASIS. Jack S. Krohmer and Frederick J. Bonte (Univ. of Texas Southwestern Medical School and Parkland Memorial Hospital, Dallas). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 269-74(Aug. 1962).

A procedure is described for scintillation scanning of the liver in which a tape recording system allows display of the recorded information with a 60 to 1 speed-up. It is concluded that this system will allow better visualization of all types of scintillation scanning information. (C.H.)

25099 SCINTILLATION SCANNING OF THE LIVER. II. CLINICAL APPLICATIONS. Frederick J. Bonte, Jack S. Krohmer, Ernest Elmendorf, Norman L. Presley, and Giles J. Andrews (Univ. of Texas Southwestern Medical School and Parkland Memorial Hospital, Dallas). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 275-88 (Aug. 1962).

Radioisotope scintillation scanning of the liver has been practiced in a number of institutions for over five years but its use is still not widespread. It may be performed reliably with most commercially available systems, if they are suitably adapted to this technique. Patient radiation exposure is not sufficient to outweigh the medical evidence obtained. Although liver scanning will give certain information about changes in size and shape of the liver, it is principally useful in estimating the position of the liver with respect to that of an apparently elevated right diaphragmatic leaf, as in subphrenic abscess formation, and in demonstrating the derangements of internal pattern produced by space-occupying lesions. It is a valuable test to employ in the study of patients who are thought to have, or who are being treated for, malignant neoplasms. The procedure is subject to certain errors. These are due to the equipment with which it is performed, the distribution of disease within and about the liver, as well as to the human error of interpretation. With certain projected improvements in equipment and additional experience on the part of the observer, this important radioisotope test will become an accurate diagnostic technique. (auth)

25100 ESTIMATION OF LIVER SIZE BY THE MULTIPLE CUT OFF SCINTILLATION SCANNING TECHNIQUE. Rauf Yagan, William J. MacIntyre, and James H. Christie (Highland View Hospital and Western Reserve Univ., Cleveland). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 289-95(Aug. 1962).

An objective method of determining liver size, even in cases where the margins are obscured clinically and roentgenographically, using the multiple cut off scintillation scanning technique is described. Comparison with postmortem data indicates an accuracy of ± 11.6%. Methods of improving this accuracy are discussed. (auth)

25101 CONTRAST ROENTGENOGRAPHY VERSUS RADIOISOTOPE SCANNING OF LIVER AND SPLEEN. J. Gershon-Cohen, J. F. McClendon, and D. M. Sklaroff (Albert Einstein Medical Center, Philadelphia). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 304-10 (Aug. 1962).

During the past decade, we have solved the problem of making nontoxic colloidal sols of tantalum pentoxide and other heavy metals for hepatosplenography in small animals. The advances made with scintiscanning and photoscanning techniques during the past decade point to fruitful methods of obtaining evidence of disease of the liver and spleen. Most promising is the advent of new and better means of detecting malignancy, not only on the surface, but also in the depths of so large an organ as the liver without resorting to exploratory laparotomy. The spawning of new apparatus, the imaginative experimentation with new types of collimators, the increasing availability of a wider range of more versatile isotopes and the adaptation of television techniques signalize emergence of a bright new diagnostic field in nuclear medicine. Some early achievements in this area are illustrated. (auth)

25102 THE USE OF "TUMOR" AND "BRAIN" PHANTOMS IN THE INTERPRETATION OF POSITRON ANNIHILATION AND UNBALANCE SCAN OF BRAIN TUMORS. Lillian E. Jacobson, Wade N. Miller, William R. Hillsinger, and Fred S. Einstein (United Hospitals of Newark, N. J.). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 339-49(Aug. 1962).

Positron annihilation and unbalance scans were made of a tumor in a brain phantom using a fixed concentration of As^{74} in the brain phantom while varying the volume, concentration and position of the tumor phantom. Unbalance scanning is more sensitive than positron scanning. Unbalance prints appear when there is no discernible difference in the positron prints. In this study a 4 cc volume with a 15/1 ratio of concentrations could be detected on the unbalance scan at 2 cm to the right or the left of center. An

8 cc tumor volume was needed to give a discernible positron scan. The definition of the tumor phantom on the positron scan is good, while that on the unbalance scan is diffuse. There is equal definition on the positron scan, whether the tumor phantom is at the center or to the right or the left of the midplane. A cold tumor, as simulated by having water in the tumor phantom, cannot be detected on the positron scan up to a 124 cc volume, the largest investigated in this study, but does appear on the unbalance scan. Location of the tumor phantom to the right of the midplane appears as leftsided prints and vice versa. An analysis of patient brain scans is given in terms of the findings in the phantom work. The scans are very sensitive to the voltage across the photomultiplier tube. A tumor phantom of 8 cc volume with a tumor to brain concentration of 15/1 is hardly discernible in a positron scan with a voltage setting of 1,000 volts, but is clearly seen at 1,100 volts. A method of balancing the right and left circuits, by which the test tube of As^{74} is surrounded by unit density scattering material, simulates conditions for the head more closely than test tube alone. (auth)

25103 A SENSITIVE METHOD FOR THE DETECTION OF TRITIUM-MARKED β-INDOLYLACETIC ACID IN PLANT CELLS AND TISSUES AT PHYSIOLOGICAL AND EXPERIMENTAL CONCENTRATIONS. J. Figier, L. Khau Van Kien, and E. Roux. Ann. histochim., 5: 399-44(1960). (In French)

The localization of β-indolylacetic acid (AIA), a growth auxin, was attempted using C^{14} and tritium as tracers. The radioauto histographic detection method depends on the insolubilization of AIA in situ by picric acid and basic lead acetate at a suitable pH, the AIA being protected from histological solvents. The results of the detections corresponding to physiological responses during growth tests on Pisum, Avena, Phaseolus, and Vicia, at concentrations of 10^{-5} and higher make possible the localization of tissues in agreement with the auxinic activity and with the relations already known between AIA and cellular formations. By increasing the time of exposures of the sections, it will be possible to attain concentrations which are much lower and more clearly physiological. (auth)

25104 TRACING OF INTRAVENOUSLY INJECTED METAL SULPHIDE COLLOID IN RABBIT. László Kértesz. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 3: 17-36(Apr. 1961). (In Hungarian)

Discussion is given on the time-test of the storage tendency in individual organs. It is emphasized that the concept of biological or pharmacological half-life can only be applied to processes occurring in conformity with laws exponentially depending on time. (auth)

25105 PROBLEMS OF RADIOIODINE METABOLISM, WITH PARTICULAR REGARD TO THE STEADY STATE OF THYROID GLAND FUNCTION. László Kertész. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 3: 37-42(Apr. 1961). (In Hungarian)

A method for carrying out a bloodless test in vivo for radioiodine equilibrium is presented. It is pointed out that surgical treatment previous to the establishment of radioiodine equilibrium will lead to a retardation of the equilibrial state, depending on the point and length of time of the trauma. On testing radioiodine metabolism, more attention must be paid to the role of the extrathyroidal iodine-pool. In practice, the effects of operative, neural trauma as the stressogen factors influencing thyroid gland function are to be taken into consideration. (auth)

25106 A BIOLOGICAL PRINCIPLE AND ITS CONVERSE: SOME IMPLICATIONS FOR CARCINOGENESIS. P. R. J. Burch (Oak Ridge National Lab., Tenn.). Nature, 195: 241-3(July 21, 1962).

The relationship of somatic and inherited mutations in carcinogenesis is discussed, and the generalization is made that where the etiology of a neoplasm involves somatic nuclear gene mutations, individual tumors will be found in which inherited mutations have substituted for somatic. The converse should also be valid, i.e., where Mendelian inheritance of a neoplasm can be demonstrated, somatic mutations should also contribute to its genesis. An analysis of the etiology of human leukemias is attempted, and conclusions are given on both child and adult leukemias. The mechanisms of radiogenic leukemias at Hiroshima and Nagasaki are considered along with leukemia from background radiation. (D.L.C.)

25107 EFFECT OF OUABAIN ON THE RESTING TENSION AND THE RATE OF NET ENTRY OF CALCIUM-45 IN ISOLATED PERFUSED RABBIT VENTRICLES. A. H. Briggs and W. C. Holland (Univ. of Mississippi Medical Center, Jackson). Nature, 195: 294-5(July 21, 1962).

The rate of net entry of Ca^{45} was determined in rabbit heart ventricles by perfusing the hearts with the isotope and with and without ouabain, washing the heart, and determining the activity of the ventricular tissues. The results show that ouabain significantly increased the mean Ca^{45} net entry rate by 116% and the mean resting tension by 45%. A good positive correlation was also found between resting tension and the Ca^{45} net entry rate. It is concluded that contractures induced by ouabain in both rabbit atria and ventricles are probably due to an increased calcium concentration in the cardiac cell. (D.L.C.)

25108 IMMUNIZATION OF THE A/JAX MOUSE WITH IRRADIATED CELLS OF ITS INDIGENOUS TUMOUR, SARCOMA I. John W. Jutila, Russell S. Weiser, and Charles A. Evans (Univ. of Washington, Seattle). Nature, 195: 301 (July 21, 1962).

Adult A/Jax mice were treated with irradiated Sarcoma I (SaI) ascites tumor (18,000 to 36,000 r) and then challenged with a lethal dose of SaI cells. The results show that whereas all the control mice died of tumor before the 21st day, many of the treated mice survived for longer periods. It is concluded that irradiated SaI ascites tumor cells are immunogenic for the A/Jax mouse and that antigenic differences exist between the mouse and its indigenous tumor SaI. (D.L.C.)

25109 BONE MARROW TRANSPLANTATION, A PROBLEM IN IMMUNOLOGY. T. Makinodan (National Inst. of Radiological Sciences, Chiba, Japan and Oak Ridge National Lab., Tenn.). Nippon Ketsueki Gakkai Zasshi, 24: 103-10(Dec. 1961). (In English)

An attempt was made to establish that bone marrow transplantation is basically a problem in incompatibility. The fact that the biologic integrity of an individual is governed by his immune machinery means that an understanding of incompatibility requires a comprehensive knowledge of the mechanism and ontogeny of this machinery. Unfortunately, our knowledge of it is, at best, very meager. An attempt was made in this paper to discuss in detail only one line of investigation of the problem of incompatibility, the radiosensitivity of antibody-forming cells. In reviewing this problem it should be apparent that, although many were prone to consider the use of radiation in immunologic studies as being rather applied, the judicious use of radiation has served, and will continue to serve, as one of the essential tools in our attempt to understand the complex process involved in the immune mechanism. (auth)

Biochemistry, Nutrition, and Toxicology

25110 (CEA-2155) ETUDE BIOLOGIQUE D'UNE PEINTURE LUMINEUSE TRITIEE. (Biological Study of a Tritiated Luminous Paint). J. Remy, J. Meunuer, and A. Aeberhardt (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 12p.

A powdered mixture of zinc sulfide and a tritiated polyester was administered to rats by means of the esophagal probe. The distribution of tritium in the organ, and its eliminstion, were studied. From 75 to 80% of the polyester underwent sufficient degradation in the intestinal medium to be absorbed by the digestive mucous membrane and to be subjected to metabolic reactions. (auth)

25111 (HW-72500) HANFORD BIOLOGY RESEARCH ANNUAL REPORT FOR 1961. H. A. Kornberg and E. G. Swezea, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1962. Contract AT(45-1)-1350. 183p.

Results are reported from a number of studies dealing with toxicity and metabolism of radioelements, radioelement deposition and radiation response, animal and cellular physiology, plant physiology, and ecology. Data are included from radiobiological monitoring in the Hanford area. A list is included of publications and lectures during the period covered. Separate abstracts were prepared on 38 sections of this report. (C.H.)

25112 (HW-72500(p.1-12)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE—SECOND PROGRESS REPORT. R. O. McClellan, J. R. McKenney, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Additional levels of Sr^{90} feeding were initiated at 625 and 3, 100 μc/day, bringing to six the number of levels of Sr^{90} being fed daily. With 154 animals on Sr^{90} feeding, essentially all animals scheduled for daily Sr^{90} feeding are now on experiment. Radiation dose rates to the bone and active marrow of animals maintained on 25 μc/day of Sr^{90} since conception were estimated by scanning of autoradiographs of thick sections of the tibia. The average cumulative radiation dose to the active marrow and bone for the first year of life was estimated at 1,200 and 1,600 rads, respectively. No apparent changes have occurred in the birth weight, growth rate, gross clinical condition, or radiographic appearance in any animal fed 1, 5, 25, or 125 μc/day. Changes in blood constituents are limited to a slight reduction in neutrophils in nine-month-old animals at the 125 μc/day level, a severe neutropenia in animals fed 625 μc/day for three months and 3,100 μc/day for two months, together with a severe reduction in the platelet count on the swine fed 3,100 μc/day. There was a suggestion of a drop in the lymphocyte count in the two highest level groups and an increase in plasma clearance of Fe^{59} in some animals fed 25 μc/day for 18 months. Approximately 2% of the daily ingested Sr^{90} appeared in the milk each day. The estimated daily milk production was 1,100 ml. Discrimination against Sr^{90} relative to calcium in passage from diet to milk was approximately 10. The milk concentration of Sr^{90} and calcium increased significantly during the lactation period while the plasma concentrations of these elements remained fairly constant. (auth)

25113 (HW-72500(p.13-14)) EFFECT OF AGE ON RETENTION OF STRONTIUM AND CALCIUM. R. O. McClellan, A. C. Case, and H. W. Casey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Marked differences in retention at 10 to 14 days post-administration of intravenously administered Ca^{47} and Sr^{85} were seen in miniature swine of different ages, varying from approximately 90% at 30 to 40 days of age to 40% at 1,500 days of age. (auth)

25114 (HW-72500(p.15-18)) INTESTINAL ABSORPTION OF Sr^{85} AND Ca^{45}. F. R. Mraz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Using an in vivo perfusion technique, the absorption of Sr^{85} and Ca^{45} from the small intestine of the rat was observed to be influenced by the alkaline earths and pH. Addition of calcium or beryllium to the perfusate reduced Ca^{45} absorption more than Sr^{85} absorption. Magnesium and barium had a greater effect on Sr^{85} than on Ca^{45}, while strontium reduced the absorption of Ca^{45} and Sr^{85} to the same extent. Extremes in pH tended to increase the ratio of Sr^{85} to Ca^{45} absorption. (auth)

25115 (HW-72500(p.19-22)) INTERRELATIONSHIPS OF CALCIUM, STRONTIUM, AND PHOSPHATE IN SERUM. J. R. McKenney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effects of in vitro additions of $CaCl_2$ and slight variations in pH on the concentrations of ultrafiltrable calcium, inorganic phosphate, Ca^{45}, and Sr^{85} in sheep serum were studied. An inverse relationship was observed between the concentrations of ultrafiltrable calcium and inorganic phosphate. Although Sr^{85} was slightly more ultrafiltrable than calcium, effects upon ultrafiltrability of Sr^{85} were similar to those for calcium. With an increase in pH, the solubility products for calcium phosphates were decreased in some animals. (auth)

25116 (HW-72500(p.23-5)) MOVEMENT OF STRONTIUM ACROSS THE GILL OF TROUT. R. H. Schiffman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A perfusion technique was used to determine the effect of calcium, phosphate, and pH on the influx rate of strontium across trout gills. The strontium influx was not affected by varying the calcium concentration in the external medium. Phosphate on either side of the gill caused an increased influx rate that was decreased by 2,4-dinitrophenol thus suggesting strontium is actively transported. As pH increased the strontium influx rate decreased. (auth)

25117 (HW-72500(p.26-9)) DISTRIBUTION AND RETENTION OF Sr^{90}–Y^{90} IN TROUT. R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

After trout were fed a single dose of 15 μc Sr^{90}–Y^{90}, the concentration of the isotope in various tissues was followed as a function of post-administration times. All tissues showed a sharp increase in Sr^{90}–Y^{90} concentration within the initial 24-hour period, and with the exception of bone, declined rapidly thereafter. After 16 days bone had a concentration of 0.2 μc/g which decreased to 0.05 μc/g at 100 days. The per cent of administered dose retained by trout averaged 25 per cent at 24 hours and then gradually decreased to about 4.4 per cent at 100 days. (auth)

25118 (HW-72500(p.30-5)) BIOLOGICAL EFFECTS OF I^{131} IN SHEEP AND SWINE. L. K. Bustad, J. W. Cable, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Maximum thyroid uptake of orally administered I^{131} was 25% in newborn lambs and 35% in one- to two-week-old lambs. For both groups I^{131} content of the lambs' thyroids approached a constant fraction (60 to 75%) of I^{131} in their bodies at three to five days after administration. Comparison of equilibrium concentrations of I^{131} in excretions of a

limited number of swine and sheep showed that in swine urinary excretion of I^{131} predominates, while in sheep slightly more I^{131} is excreted in the feces than the urine. Equilibrium tissue concentrations of sheep were generally greater with I^{131} values in blood, bile, ovary, lung, and spleen being four or more times higher in sheep than swine. A thyroid adenoma was observed for the first time in a ewe fed 0.15 μc/day for about ten years. This may reflect the naturally occurring incidence in these sheep, since thyroid adenomas were observed in aged control ewes previously. Sheep given single 3-mc doses of I^{131} in 1958 and 1959 have only minimal thyroid tissue remaining and some of the surviving animals in these groups manifest symptoms of serious hypothyroidism. (auth)

25119 (HW-72500(p.36-40)) COMPARATIVE TOXICITY OF Sr^{90}, Ra^{226}, AND Pu^{239}. R. O. McClellan, Glenda S. Vogt, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Twenty-one female miniature swine were injected intravenously with Sr^{90}, Ra^{226}, or Pu^{239}. Severe reduction in leukocyte numbers were seen during the first three months after radionuclide injection. Nine male animals injected 18 months previously and their controls were sacrificed to provide specimens for study of early histopathological and histochemical changes. (auth)

25120 (HW-72500(p.41-3)) METABOLISM OF NEPTUNIUM. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Gastrointestinal absorption of Np^{237} contained in an industrial dust sample ranged from 0.1% to 1% of the dose following acute and chronic ingestion. Intestinal absorption of neptunium citrate solutions ranked according to valence state is Np VI > Np V > Np IV. Absorption of the most stable form, Np V, was about 1% of the administered dose. (auth)

25121 (HW-72500(p.44-9)) TRANSFER OF HEAVY RADIONUCLIDES TO MILK. R. O. McClellan, H. W. Casey, et al. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The transfer from plasma to milk of Ce^{144}–Pr^{144}, Np^{237}, Pu^{239}, and Am^{241} was determined following intravenous administration to lactating sheep. The average milk-to-plasma ratios were: Ce^{144}–Pr^{144}, 3.4; Np^{237}, 0.05; Pu^{239}, 0.025; and Am^{241}, 2.3. (auth)

25122 (HW-72500(p.50-1)) EFFECTS OF INTRADERMAL INJECTIONS OF PLUTONIUM. J. W. Cable, V. G. Horstman, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Eight blond miniature swine, six being held for lifetime observations, were injected intradermally with doses of 0.0016 to 5 μc plutonium nitrate at various sites on the lateral thoracico-abdominal region. The quantity of plutonium detected by external monitoring of the sites injected with the three highest dose levels varied from 98% at one day to less than 2% after 565 days. A considerable variation in the degree and duration of the gross pathology, e.g., inflammation and size of ulcer, occurred between similar sites among animals. (auth)

25123 (HW-72500(p.52-5)) BIOLOGICAL EFFECTIVENESS OF I^{127} AS A DILUENT OF I^{131} AEROSOL. W. J. Bair (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The simultaneous release of nonradioactive iodine with I^{131} vapor reduced the percentage of the total I^{131} deposited that was taken up by the thyroid, but did not reduce the total amount deposited in the rat. (auth)

25124 (HW-72500(p.56-60)) INHALATION OF DUST CONTAINING Np^{237}. W. J. Bair and A. C. Case (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Following inhalation of Np^{237} as a contaminant of an industrial dust, about 2% of the total deposited was retained in lungs of rats three weeks after exposure. More than 90% was excreted in feces and about 2% in urine. In 30-day toxicity tests only three deaths occurred in 14 rats at the highest dose level of about 200 pc deposited in the lung. Possible kidney damage was indicated in several rats, although histologic changes were marginal. The apparent toxicity was considered to be due to the uranium and fluoride content rather than the Np^{237} content of the dust. (auth)

25125 (HW-72500(p.61-6)) RETENTION, TRANSLOCATION, AND EXCRETION OF INHALED PLUTONIUM. W. J. Bair, J. P. Herring, and L. A. George, II (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The retention, translocation, and excretion of plutonium in dogs are compared for inhalation of six different plutonium dioxide aerosols and for plutonium nitrate. The translocation and excretion of Pu^{239} were significantly greater after inhalation of $Pu^{239}O_2$ aerosol with a count median diameter (CMD) of 0.12 μ than after inhalation of aerosols with CMD's of 0.3 μ to 0.60 μ. The rate of urinary excretion expressed as per cent of the body burden was about five times greater after inhalation than after intravenous injection of plutonium nitrate, although the same total amount was excreted over a 30-day period. (auth)

25126 (HW-72500(p.67-73)) RADIOGRAPHIC AND CLINICAL CHANGES FOLLOWING INHALATION OF $Pu^{239}O_2$. J. F. Park (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Thoracic radiographs of a beagle dog following an acutely lethal dose of $Pu^{239}O_2$ did not show definite changes until two days before death. The radiographic changes detected were diffuse mottling and increased density of the entire lung field, slight cardiac enlargement, increased density and distention of the pulmonary arteries, increased density of the anterior vena cava, and minute opacities in the thoracic aorta. Clinical respiratory changes were first apparent five weeks before death. (auth)

25127 (HW-72500(p.74-6)) REMOVING INHALED RADIOACTIVE PARTICLES. W. J. Bair and R. A. Hennacy (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

After inhaling $Ce^{144}O_2$, rats were treated with India ink, chlorpromazine, negative ions, or cyanacethydrazide. None of these treatments markedly increased the pulmonary clearance of Ce^{144}, although the latter two showed slightly positive results. (auth)

25128 (HW-72500(p.77-80)) REMOVAL OF INTERNALLY DEPOSITED PLUTONIUM. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Preliminary tests indicate the complexing agent triethylenetetramine hexaacetic acid (TTHA) is as effective as diethylenetriamine pentaacetic acid (DTPA) when given intraperitoneally and more effective than DTPA when administered orally. The range of toxicity and therapeutic effectiveness of TTHA has not yet been clearly defined. (auth)

25129 (HW-72500(p.81-3)) PROTECTION AGAINST REPEATED PARTIAL-BODY IRRADIATION. M. F. Sullivan and R. C. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Cysteine was shown to be particularly effective in protecting against repeated radiation exposures limited to the

lower body or abdominal area of rats. Under certain circumstances the cumulative dose required to kill protected animals was as much as seven times that which was fatal to unprotected animals. (auth)

25130 (HW-72500(p.84-7)) WATER ABSORPTION FROM INTESTINE TO LYMPH AND BLOOD. Ahmet Noyan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Using tritiated water it was found that about 97% of the absorbed water entered the blood and 3% entered the lymph from the small intestine of rats. (auth)

25131 (HW-72500(p.88-91)) DELAYED EFFECTS OF Y^{90} INGESTION. M. F. Sullivan, S. Marks, and R. C. Thompson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Female rats were maintained for 60 days on drinking water containing Y^{90}. A high-level group of 50 animals ingested an average of 410 μc/day; a low-level group of 50 animals ingested 90 μc/day. Median post-treatment survival times were 350 days for the high-level group, 434 days for the low-level group, and 626 days for controls. Histopathologic study of the intestinal tract indicated virtually complete recovery of the early damage and only one intestinal tumor was observed among the exposed animals. Numerous uterine tumors and tumors of the oral region were correlated with Y^{90} exposure. (auth)

25132 (HW-72500(p.92-6)) EFFECTS OF RADIATION ON CHANGES IN THE REGENERATING LIVER. E. M. Uyeki (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The temporal pattern of cation and protein distribution in the regenerating liver was shown to be biphasic. On the basis of wet weight there is an initial phase in the first 24 hours post-hepatectomy in which water and sodium are increased in tissues concomitant with a decrease in potassium and protein. The levels of these several constituents subsequently approach values that are higher than control at one and two days and generally maintain these values throughout the assay period. A decrease in the potassium content of the soluble fraction at 12 hours post-hepatectomy was found to be the main consequence of x radiation. (auth)

25133 (HW-72500(p.97-101)) AUTORADIOGRAPHIC LOCALIZATION OF Zn^{65}. N. L. Dockum (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Autoradiographic localization of Zn^{65} in rat tissue by the use of thin NTB^2 emulsions permitted the registration of Auger electrons. Resolution of less than 1 μ was obtained. (auth)

25134 (HW-72500(p.102-3)) DEVELOPMENTAL ARREST OF IRRADIATED EPHESTIA LARVAE. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Massive doses of x rays (20 kr or more) to moth larvae caused irreversible developmental arrest. Various radiation-induced effects were observed. Damage to mitotically active imaginal discs and/or to the neurosecretory complex was implicated. (auth)

25135 (HW-72500(p.104-8)) EFFECTS OF X-RADIATION ON PROLIFERATING CELLS. J. Van't Hof (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A system was defined for use in studying the effects of x-radiation on the DNA, RNA, and protein syntheses of proliferating cells. Using sample data from various experiments and a model representing mitosis, the effects of x radiation on dividing cells were illustrated. (auth)

25136 (HW-72500(p.109-12)) UPTAKE AND DISTRIBUTION OF THYMIDINE BY YEAST. R. T. O'Brien and E. Jane Coleman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Preliminary results on H^3 thymidine incorporation in a thymine-requiring yeast indicate that radioactivity is shared equally between parent cell and bud at the first division. (auth)

25137 (HW-72500(p.113-18)) EFFECTS OF DEUTERIUM OXIDE ON YEAST. R. T. O'Brien (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Growth and respiration of haploid yeast cells are inhibited by 99.5 per cent D_2O. Uptake of metabolites is also inhibited with phosphate uptake being most sensitive. Radiation sensitivity was decreased by growing cells on D_2O media. (auth)

25138 (HW-72500(p.119-22)) UPTAKE OF ARSENATE BY BARLEY PLANTS. D. A. Barber, F. P. Hungate, and J. D. Stewart (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The uptake by barley plants of arsenate from three different soils and the effect of phosphate addition on this uptake was studied. There was a correlation between the organic matter content of the soils and the amount of arsenate taken up. Phosphate addition increased As^{74} uptake most from soils having the least organic matter. (auth)

25139 (HW-72500(p.123-7)) INHIBITORY EFFECTS OF CHLORAMPHENICOL ON CATION ABSORPTION BY PLANTS. R. L. Uhler (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Chloramphenicol, a protein synthesis inhibitor, was found to retard uptake of calcium and rubidium by young barley plants. Accumulation in both shoots and roots was reduced, and to a lesser extent, translocation and transpiration. Respiration of excised roots was not affected. (auth)

25140 (HW-72500(p.128-33)) EFFECT OF 2, 4-DINITROPHENOL ON CALCIUM ACCUMULATION AND TRANSPIRATION. H. V. Koontz and D. A. Barber (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Dinitrophenol (DNP) reduced transpiration and initially decreased and then increased calcium accumulation in barley seedlings. However, when exposure of the roots to the inhibitor lasted for more than 12 hours, the net amount of calcium accumulated in the shoots decreased. The effect on transpiration appeared to be determined by presence of the inhibitor in the shoot, whereas calcium accumulation in the shoot was affected by the action of DNP on the roots. Transpiration and calcium accumulation were concluded to be essentially separate processes. (auth)

25141 (HW-72500(p.134-8)) EFFECT OF NUTRIENT POTASSIUM AND CESIUM ON UPTAKE OF CESIUM-137 BY PLANTS. J. F. Cline (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Accumulation of Cs^{137} was largely independent of potassium concentrations, indicating that discrimination by plants of these two elements changes. Cesium toxicity and factors affecting severity of toxicity are described. Visual toxicity was observed when potassium and cesium approached equal concentrations in the substrate. (auth)

25142 (HW-72500(p.139-43)) RADIOISOTOPES IN STUDYING WATERFOWL DISPERSION. W. C. Hanson and A. C. Case (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A method to investigate dispersion of waterfowl is described in which heads from birds harvested by hunters are

analyzed for radioisotopes originating from the Hanford reactors. Initial results indicated migration pattern and that 41% of the waterfowl harvested within a fifty-mile radius of the Hanford Reservation during the 1960 to 1961 hunting season were tagged with P^{32} from the Columbia River. (auth)

25143 (HW-72500(p.144-7)) REACTOR EFFLUENT MONITORING WITH SALMON, 1960-1961. P. A. Olson and R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Comparisons of the mortality and growth between groups of young chinook salmon reared in concentrations of 0, 4, and 8% reactor effluent water showed significantly greater mortality in the 8% group, but not between the 4 and 0% groups. The accelerated growth rate of the 4 and 8% groups is attributed to the elevated water temperatures. (auth)

25144 (HW-72500(p.148-50)) CHINOOK SALMON SPAWNING IN THE COLUMBIA RIVER. D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The number of chinook salmon spawning in the Columbia River near Hanford was the second highest since surveys were started in 1947. Priest Rapids Dam appears to affect the distribution and number of spawning fish in this area. (auth)

25145 (HW-72500(p.151-5)) INCIDENCE AND VIRULENCE OF COLUMNARIS. M. P. Fujihara and P. A. Olson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Fish samples from the Columbia River system showed a low incidence of columnaris disease compared to fish from an artificial spawning channel. Strains collected varied from avirulent to highly virulent. Ploidy of C. columnaris was found to have questionable significance to virulence differences although high virulent strains tested were diploid and avirulent haploid. Prolonged sublethal irradiation had no effect on virulence. (auth)

25146 (HW-72500(p.156-8)) X-RAY TOLERANCE OF TWO RELATED SPECIES OF BEETLES. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Sterilizing and lethal x-ray doses were determined for various developmental stages of Tribolium confusum and Tribolium castaneum. Under the experimental conditions, T. castaneum was more x-ray resistant than T. confusum. Radiotolerance of both species increased as development and differentiation progressed; the one-to-three hour ovipositied egg was the most sensitive stage. (auth)

25147 (HW-72500(p.159-60)) HARVEST YIELDS IN NATURAL PLANT COMMUNITIES. W. H. Rickard, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The forage yield of fruiticose lichens in an arctic lichen community amounted to about 420 pounds of oven-dried forage per acre. An arctic sedge community produced about 270 pounds of forage while a cheatgrass community at Hanford produced about 190 pounds per acre during growing seasons of 75 and 180 days, respectively. (auth)

25148 (HW-72500(p.161-4)) PRODUCERS AND DECOMPOSERS IN A DESERT SOIL. W. H. Rickard, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Chlorophyll content, organic matter, Kjeldahl nitrogen, and nitrate plus nitrite nitrogen were compared in laboratory-cultured desert soil samples. After 18 days in light or darkness, organic matter and Kjeldahl nitrogen decreased sharply while nitrate plus nitrite nitrogen increased. Chlorophyll content increased under the light treatment. (auth)

25149 (HW-72500(p.165-9)) RADIONUCLIDES IN ARCTIC PLANTS AND ANIMALS. J. J. Davis, W. C. Hanson, D. G. Watson, and W. H. Rickard, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Amounts and distribution of radionuclides from fall-out in the Alaskan Arctic biota during 1960 are reported. Among plants highest levels occurred in lichens and marshland species. Interspecies differences in isotopic concentration among animals were associated with environments and food habits. Among all animals sampled caribou generally contained the highest levels of gamma emitters. (auth)

25150 (TID-15963) RATES AND PATTERN OF MOVEMENT OF RUBIDIUM^{86} AND PHOSPHORUS^{32} IN A CENTRAL MESOPHYTIC FOREST, PARKE COUNTY, INDIANA. Annual Progress Report. Robert Petty (Wabash Coll., Crawfordsville, Ind.). Feb. 25, 1962. Contract AT(11-1)-1006. 54p.

Terrestrial mineral cycling in a central mesophytic forest was studied at the Allee Memorial Woods in West Central Indiana. The Allee Woods has been under continual ecological study for the past 4 years, resulting in a detailed description of the virgin beech-maple forest, midseral oak stand, and an abandoned field used as the reference ecosystems. Selected trees were inoculated with Ru^{86} or P^{32} and the rate of migration from leaves to soil was determined. Data were compared with detailed microclimatic data for the same period as well as microorganism and arthropod population levels. (C.H.)

25151 (TID-16073) FACTORS INFLUENCING THE METABOLISM OF COPPER AND IRON. Seventh Year Progress Report, July 1, 1961 to May 31, 1962. Kenneth J. Monty (Johns Hopkins Univ., Baltimore). June 15, 1962. Contract AT(30-1)-1816. 21p.

Progress is reported in studies of the mechanism whereby molybdate interferes with the utilization of inorganic sulfate in Escherichia coli, the basic pathway of inorganic sulfur metabolism in Salmonella typhimurium, the mechanism for molybdate-induced copper deficiency in rats, and the nature and regulation of inorganic sulfur metabolism in certain bacteria. (C.H.)

25152 (TID-16075) [PROGRESS REPORT ON BIOCHEMISTRY], SEPTEMBER 15, 1961 TO SEPTEMBER 14, 1962. Roger M. Herriott (Johns Hopkins Univ., Baltimore. School of Hygiene and Public Health). Contract AT(30-1)-1371. 27p.

Progress is reported in studies of the mechanism of formation of heterozygotes or hybrid transforming DNA units of Hemophilus influenzae, the effects of Lehman's phosphodiesterase on the heterozygotes, demonstration of a unique type of transforming DNA, a transformational analysis of the role of porphyrins in H. influenzae, variables that affect DNA uptake by competent cells, the mutagenic action of nitrous acid on denatured Hemophilus transforming DNA, and the effects of ultraviolet light on single stranded Hemophilus DNA. A list is included of publications during the period covered by this report. (C.H.)

25153 (UCD-106) THE EFFECTS OF CONTINUAL Sr^{90} INGESTION DURING THE GROWTH PERIOD OF THE BEAGLE AND ITS RELATION TO Ra^{226} TOXICITY. Annual Progress Report No. 6. A. C. Andersen (California. Univ., Davis. School of Veterinary Medicine). June 1962. Contract AT(11-1)-GEN-10. 138p.

Progress is reported in studies of the long-term effects of Sr^{90} and Ra^{226} in beagles. Building, facilities, and procedures for care and breeding of animals are described. The

growth and development of the beagle skeleton is discussed. Data are presented on the stable Sr content of food and in bones of beagles and the skeletal uptake of ingested Sr^{90}. A whole-body counter is described that will permit measurements of radionuclide burdens in living beagles at very low levels. (C.H.)

25154 (UR-578) BEHAVIORAL CHANGES IN THE PIGEON FOLLOWING INHALATION OF MERCURY VAPOR. R. D. Armstrong, L. J. Leach, P. R. Belluscio, E. A. Maynard, and H. C. Hodge (Rochester, N. Y. Univ. Atomic Energy Project). June 5, 1962. Contract W-7401-eng-49. 29p.

A pigeon, motivated by food deprivation, was trained to peck on a translucent key in order to obtain a reward, food. The bird was then conditioned, in stages, to respond to more complex conditions, which included associating colored light with variations in the required pecking pattern. For example, when the key light was red, food was presented after each 60 pecks (a rate factor or fixed ratio); when the light was green, the first peck after 15 minutes was rewarded (a time factor or fixed interval). When stable behavior was established, the pigeon was then exposed to mercury vapor. Following inhalation of mercury at about 17 mg/m^3, marked changes in behavior occurred, as measured by a decrease in both the average number of pecks per fixed interval and the average number of pecks per second during fixed ratios. These parameters recovered to more nearly normal values when exposure was terminated. (auth)

25155 NON-EXCHANGEABILITY OF ^{28}Mg WITH CHLOROPHYLL a. S. Aronoff (Univ. of California, Berkeley). Biochim. et Biophys. Acta, 60: 193-5(June 18, 1962). (In English)

Results of studies on Chlorella, grown in a mg-reduced medium supplemented with carrier-free Mg^{28}, showed that Mg^{28} does not exchange in aqueous acetone with the Mg of chlorophyll a. A practical consequence of this absence of exchange is that the absolute kinetics of chlorophyll biogenesis or turnover may be studied without the concern of exchange with preformed chlorophyll. (C.H.)

25156 P^{32} EXCRETION IN BILE IN RABBITS. T. Ichinohe (Hirosaki Univ. School of Medicine, Japan). Hiroshima Igaku, 13: No. 1, 5-8(1961).

The determination of the concentration of P^{32} in the liver parenchyma, bile, and serum after subcutaneous injections of P^{32} was carried out in healthy rabbits and in those with livers damaged by carbon tetrachloride. In rabbits with hepatic damage, P^{32} concentration in serum and bile was much lower than normal, and the quantity of P^{32} accumulated in the liver parenchyma was 1.5 to 2.0 times higher than in the normal controls. (Abstr. Japan Med., 2: No. 6, June 1962)

25157 DISTRIBUTION OF RADIOACTIVE CESIUM AND STRONTIUM IN HUMAN AND ANIMAL ORGANS. L. G. Shakhidzhanyan, A. S. Starik, D. G. Fleishman, V. V. Glasunov, V. G. Leontev, and V. P. Nesterov (Inst. of Evolutionary Physiology, Academy of Sciences, Leningrad). Izvest. Akad. Nauk Eston. S.S.R., Ser. Biol., No. 3, 442-8 (May-June 1962). (In Estonian)

The metabolism of Cs^{137} in animals and human was studied in order to ascertain the mechanism that bars Cs^{137} passage into the brain. (R.V.J.)

25158 INTERNAL DISTRIBUTION OF URANIUM COMPOUNDS IN THE BODY AND ACUTE URANIUM POISONING. (English Text). T. Kitabatake and Y. Mizutani (Nagoya Univ. School of Medicine, Japan). Nagoya J. Med. Sci., 24: No. 2, 133-8(1961).

Uranium in animals was measured by counting the beta-rays emitted. Uranium concentration in the blood was maximum 6 hours after injection, and then gradually decreased. Deposition in the liver, spleen, adrenal glands, and muscles paralleled the blood level. In the kidneys, however, uranium fragmentation gradually increased with time until it reached up to 9% of the injected dose at the end of 48 hours. The same tendency was also seen in the bones. Rats injected intraperitoneally with 0.05 mg of soluble uranium all died within about 30 hours. Microscopically, moderate hyperemia, bleeding in the stroma, and hyaline degeneration of the epithelial cells in the renal tubules were seen in the kidneys. In the group injected with 0.001 mg, renal changes were very slight, and complete recovery took place after about 3 weeks. Rabbits exposed to inhalation of 1000 or 300 mg of insoluble uranium died after 4 to 7 days. However, rabbits inhaling 100 mg survived for more than 4 months, with normal growth rate and hematological findings. Four months after the treatment, one of these rabbits was sacrificed and examined microscopically, but no definite changes were found in the lungs or kidneys. In the heart muscles of rabbits inhaling 100 mg of insoluble uranium some alpha-tracks were detected radioautographically, indicating that some uranium dust may have been taken up into the blood stream. (Abstr. Japan Med., 2: No. 6, June 1962)

25159 EFFECTS OF LEOPON ON RADIATION ANEMIA SEEN AMONG CANCER PATIENTS DURING RADIOTHERAPY. H. Yoshimoto (Sakai Hospital, Tokyo). Naika No Ryoiki, 8: No. 11, 745(1960).

Leopon (adenine preparation) was fairly effective for radiation anemia seen among patients with malignant tumours, during radiation treatment. (Abstr. Japan Med., 2: No. 5, May 1962).

25160 STUDIES ON LUNG INJURIES FOLLOWING X-RAY TREATMENT OF BREAST CANCER. [PART] II. H. Ichikawa and T. Arai (Chiba Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 21: 617-26 (1961).

The highest dose in the lung was 150-160% of the air dose per one of 4 radiation portals. The part of the lung receiving the highest dose was the upper, anterior, and outer part. The lung tolerance dose was determined to be 3800 r in 30-40 days. (Abstr. Japan Med., 2: No. 5, May 1962).

25161 THE CHANGES OF PLASMIN ACTIVITY CAUSED BY RADIATION TREATMENT IN CANCER PATIENTS AND EFFECTS OF ANTIPLASMIN (IPSILON) ADMINISTRATION. H. Yamashita, S. Igari, and T. Tanaka (Cancer Inst., Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 21: No. 6, 646-55(1961).

Plasmin reaction changed from negative to positive in patients after radiotherapy. Plasmin activity was seen most often among those receiving irradiation to the abdomen and paralleled the severity of radiation sickness. In 33 cases given a large dose of ipsilon (ε-aminocaproic acid) during radiation treatment, definite inhibition of plasmin activity was observed. In 90% of the patients no radiation sickness appeared. No side-effects of ipsilon were recognized. (Abstr. Japan Med., 2: No. 6, June 1962)

25162 RADIOLOGICAL AND ELECTRON MICROSCOPIC STUDY ON ThO_2 COLLOID UPTAKE IN THE LIVER AND SPLEEN. S. Nakamura (Osaka City Univ.). Osaka Shiritsu Daigaku Igaku Zasshi, 9: Suppl. No. 4, 4113-22(1960).

Thorotrast was injected into rabbits intravenously. The liver and spleen were studied by x rays and electron

microscopy 15 min to 30 days after the injection. The grains of Th were recognized in the hepatic cells and even in the Golgi organs by means of the electron microscope. The Th, once deposited in those organs, remained without any changes for a long time, and was seen by x rays. (Abstr. Japan Med., 2: No. 5, May 1962).

25163 EXCRETION OF P^{32}. G. Koyama and M. Date (Hiroshima Univ.). Proc. Inst. Nuclear Radiation Research (Japan), 1: 47(1960).

Theoretical considerations, such as excretion rate and internal distribution and their relation, with administration dose, were given on the excretion of P^{32} administered into the subcutaneous connective tissue. Experimental data coincided fairly well with the theoretical conclusion. (Abstr. Japan Med., 2: No. 5, May 1962).

25164 UPTAKE OF RADIOPHOSPHORUS IN THE SUBCUTANEOUS CONNECTIVE TISSUE. OBSERVATION BY MEANS OF RADIOAUTOGRAPHY. S. Nagayama (Hiroshima Univ.). Proc. Inst. Nuclear Radiation Research (Japan), 1: 63(1960).

Radioactive phosphorus was taken up in histiocytes in the subcutaneous connective tissue beginning 10 minutes after injection and reaching the maximum 16 hours later. Six hours after the injection, even the fiber cells showed definite phagocytosis. Cell infiltration was recognized from 1 hour after the injection; however, no uptake of phosphorus was found in the infiltrated cells. (Abstr. Japan Med., 2: No. 5, May 1962).

25165 RADIOLOGICAL CLASSIFICATION OF SO-CALLED PULMONARY RADIATION FIBROSIS. H. Oka. Rinsho Hoshasen, 6: No. 1, 15-29(1961).

Patients treated by deep x-ray therapy following operation for breast cancer were examined periodically by chest x rays. In 52 cases of postoperative breast cancer without lung metastasis, the changes of the lung image were examined for its morphological features. Because of similarity in the x ray images, they were classified by their extent on the chest film into acinous, lobular, segmental, lobar, and linear. These radiation changes were considered to be due to fibroatelectasis. (Abstr. Japan Med., 2: No. 5, May 1962).

Fallout and Ecology

25166 (CNI-54) ELEMENTI DELLE CONDIZIONI ECOLOGICHE DELLA ZONA DI ISPRA (VARESE). (Elements of the Ecological Conditions in the Area of Ispra (Varese). C. Barigozzi, S. Boesi, M. Garofano, F. M. Gerola, M. Merlini, M. Orsenigo, and A. Toschi (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Jan. 1962. 174p.

In order to evaluate the biological conditions existing previously to the construction of Ispra-I, an ecological survey was made. It is presented in the following parts: statistic and demographic survey on the population of Ispra, Cadrezzate, and communities surrounding the Center of Nuclear Studies of Ispra; observations on the fauna in the area of Ispra, with particular reference to the fauna of venatorial interest; basis populations of the Lake Maggiore, with particular reference to plankton and fishes; and observations on the floristic-agronomic and health-phytologic conditions in the area of Ispra. Thus, it will be possible to evaluate the possible future modifications caused by the different radioactivity sources. (auth)

25167 (NP-11884) ANNUAL PROGRESS REPORT [ON BIOLOGICAL ASPECTS OF RADIATION], JULY 1, 1961–JUNE 30, 1962. Charles O. Onstead, Jon W. Blumenstock, and Erich Oberhausen (Army Medical Research Unit No. 1, Landstuhl Army Medical Center, Germany). 19p.

A two π liquid scintillation detector and an 8 × 5 in. NaI(Tl) crystal with a 256-channel γ spectrometer located in Landstuhl, Germany, were used to study radioactivity in man and his environment. The Cs^{137} content of 4000 volunteers was determined by whole-body counting. The majority of these people were residents of Germany but most other European countries were represented also. The concentrations of Cs^{137} in people was decreasing at a rate equivalent to a half-life of approximately 12 to 13 mo when atmospheric nuclear weapons testing was resumed in Sept. 1961. The Cs^{137} concentration was found to be influenced by age and sex, with relatively smaller concentrations found in children under 14 yrs of age. Potassium concentration was found to be greater in males than in females, and in both sexes a slow decrease was manifest with aging. Measurements were also made of I^{131} concentrations in patients following therapeutic administration, K concentrations in patients with cirrhosis of the liver, and Ra and Th concentrations in persons with burdens of these radionuclides, and the radioactivity in samples of rainwater and milk collected from various locations in northern Europe during 1961 and part of 1962. (C.H.)

25168 (NP-11904) ASSAY OF STRONTIUM-90 IN HUMAN BONE IN THE UNITED KINGDOM, RESULTS FOR 1961, PART I. Medical Research Council Monitoring Report Series No. 4. (Gt. Brit. Medical Research Council, London). Apr. 3, 1962. 15p.

Results are reported from the analyses of samples of human bones for Sr^{90}. The samples were from deaths occurring in Great Britain during the first half of 1961. Data are tabulated. (C.H.)

25169 (RISÖ-41) ENVIRONMENTAL RADIOACTIVITY IN DENMARK 1961. A. Aarkrog, J. Lippert, and J. Petersen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). June 1962. 139p.

Results are reported from measurements of fall-out radioactivity in Denmark in 1961. Sr-90 was determined in samples of soil, milk, vegetables, potatoes, grain, ground water, total food, and human bone collected throughout the country. Strontium-90 was also determined in local samples of air, rain water, sea water, grass, sea plants, bread, animal bone, and human milk. In the autumn a survey of the I-131 content of the Danish milk was carried out. Initial measurements of Sr-90 and Cs-137 in samples collected on Greenland and the Faroes were performed. As in previous years regular surveys were carried out on environmental samples from the Risø and Copenhagen area. (C.H.)

25170 (TID-16123) THE MEASUREMENT OF ENVIRONMENTAL RADIATION. Annual Report. (New York Univ., New York. Graduate School of Arts and Sciences). June 15, 1962. Contract AT(30-1)-1704. 74p.

Progress is reported in the study of low-energy environmental radiation. Instrumentation for measuring the composition and energy spectrum of the low-energy component was almost completed. Improvements were made in the continuous environmental radiation monitoring system including instruments for automatic integration, programming, and printout. Work was begun on a scintillation monitoring system to be integrated into the ionization chamber system. Equipment assembly was completed for the columnar recombination experiment. (M.C.G.)

25171 PLUTONIUM IN MAN AND HIS ENVIRONMENT. Philip W. Krey, Donald Bogen, and Eugene French (Isotopes, Inc., Westwood, N. J.). Nature, 195: 263-5(July 21, 1962).

An investigation was conducted on inhalation as the mode of entry of fall-out Pu into man. Analysis of air filter samples collected in Washington, D. C., in the spring of 1959 gave an average ground-level air concentration of 0.14 dpm/100 m^3, ~1% of the Pu maximum permissible concentration for the general population. Pu analyses were also made on human tissues from the New York metropolitan area and on steer tissues and beef. The results show a high percentage of the maximum permissible dose (0.3 to 0.7%) from Pu in the lungs, pulmonary lymph glands, and gonads and high Pu activities in beef spleen, stewing beef, and fluid extract from stewing beef. It is concluded that inhalation is the main mode of Pu entry into man and that the pulmonary lymph nodes are the critical organ for Pu inhalation. (D.L.C.)

Radiation Effects on Living Tissues

25172 (NP-11726) COMPARATIVE RESISTANCE OF SELECTED STRAINS OF CL. BOTULINUM IN SELECTED FOOD PRODUCTS. Report No. 9 (Final) May 15, 1961–November 15, 1961. E. Wheaton (American Can Co., Barrington, Ill.). Contract DA19-129-qm-1191. 39p.

The resistance to irradiation of spores of 5 selected strains of Clostridium botulinum was measured. Food substrates selected were green beans, chicken, cod fish, pork, and beef. Spore recovery counts indicated striking differences in radioresistance among the 5 strains studied and a degree of survival of spores in the 5 food products. (C.H.)

25173 (NP-11784) RADIOBIOLOGIC EXPERIMENTS IN DISCOVERER SATELLITE XVIII. 62-39 to 62-46. (School of Aerospace Medicine, Brooks AFB, Tex.). Mar. 1962. 38p.

Biopacks containing ampoules of bacterial spores, algae, neurospora, living human cells in culture, human serum fractions and homologous antiserum and 11 kinds of dosimeters were mounted in the nose cone of Discoverer XVIII and flown in polar orbit in space for 75 hrs on Dec. 7 to 10, 1960. The object of the experiment was to determine the biologic effect of cosmic radiations at the cellular level and to correlate the observed biologic effects with the types and intensities of measured cosmic radiations. Dose measurements, identification of particles, and the biological effects observed are discussed. Observations are compared with findings on similar biological materials exposed to a solar flare during the flight of Discoverer XVII. (C.H.)

25174 (TID-11988) CHEMICAL MODIFICATION OF RADIATION TOXICITY VIA THE COPPER COMPONENT OF CYTOCHROME c OXIDASE. I. OUTLINE OF THEORY. Jack Schubert (Argonne National Lab., Ill.). Nov. 1960. Contract [W-7405-eng-38]. 36p. (UAC-4719)

It is proposed that the primary cytoplasmic action of ionizing radiation is to promote the oxidation of the cuprous Cu component of cytochrome c oxidase. Copper is a functional component of cytochrome oxidase and is localized at the terminal position of the cytochrome respiratory chain. An acutely lethal dose of radiation is postulated to cause the irreversible oxidation of Cu(I) of cytochrome oxidase producing a cytoplasmic biochemical lesion. This results in the inactivation of the electron transport system involving the pacemaker enzyme, which is considered to be an analog of oxygen-carrying chelates in which Cu forms charge-transforming complexes with molecular oxygen. The cytoplasm lesion is assumed to contribute to the radiation damage suffered by the cell nucleus. It is pointed out that the most effective chemical protective agents against radiation toxicity are compounds that form complexes or chelates specifically with cuprous Cu, while chemical sensitizing agents are often complex-forming compounds specific for cupric Cu. Thus chemical protection is postulated to involve stabilization of Cu(I) and sensitization to involve stabilization of Cu(II) of cytochrome oxidase. Reaction mechanisms involved in both direct and indirect radiation protection and sensitization are discussed from the standpoint of the basic assumptions of the Cu(I)-Cu(II) theory. (C.H.)

25175 (TID-16051) HISTOCHEMICAL AND BIOLOGICAL ALTERATIONS FOLLOWING WHOLE BODY X-IRRADIATION. Progress Report, June 1961–June 1962. E. Kivy-Rosenberg and B. W. Zweifach (New York Univ., New York. Medical Center). Contract AT(30-1)-1680. 12p.

Results are reported from studies on the biological effects of whole-body irradiation in rats and the effects on the fetus of the exposure of pregnant rats to x radiation at various times during development. Data are tabulated. Results are included from a pilot study on the effects of radiation on development in marine forms of both vertebrates and invertebrates. A list is included of publications during the period. (C.H.)

25176 (TID-16113) STUDIES ON BIOLOGICALLY ACTIVE AMINES. Annual Progress Report, October 1, 1961 to June 15, 1962. Yutaka Kobayashi (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). June 25, 1962. Contract AT(30-1)-2085. 10p.

Progress is reported in a study of the effects of radiation on the synthesis of biologically active amines in rats. A new method for the assay of histidine decarboxylase is based on the production of radioactive CO_2 from uniformly-labeled L-histidine by the enzyme in a closed system. An evaluation was made of diamino- and triaminoguanidines as diamine oxidase inhibitors. Results are tabulated. Rats that received a lethal dose of x radiation showed an initial increase in stomach level of histidine decarboxylase at 2 hrs, followed by a rapid and complete loss of enzyme activity by 24 hr post-irradiation. The possible relationship of decreased stomach histidine decarboxylase and radiation injury was investigated. A statistically significant difference was shown in histidine metabolism in normal and schizophrenic subjects following the injection of radioactive histamine. (C.H.)

25177 (TID-16129) THE EFFECT OF EMBRYONIC IRRADIATION ON ADULT LIFE EXPECTANCY AND ADULT PATHOLOGY. Fifth Year Progress Report, July 1961–June 1962. (Jefferson Medical Coll., Philadelphia). Contract [AT-10(30-1)-2071]. 7p.

Data are summarized from a series of studies on the effect of embryonic irradiation on adult life expectancy and adult pathology in mice. A list is included of publications during the period covered by this report. (C.H.)

25178 (TID-16131) THE EFFECT OF X-RAY IRRADIATION ON THE LIPIDS OF THE SKIN. Progress Report, October 1, 1961 through June 30, 1962 and Renewal Proposal, October 1, 1962 through September 30, 1963. Henry P. Schwarz (Philadelphia General Hospital). Contract AT(30-1)-1864. 14p.

The isolation, identification, and quantitation of a single nitrogen-free phosphatide that influences the elevation of mitochondrial lipids in the liver of fasted rats following x irradiation is reported. The significance of the findings is discussed. (C.H.)

25179 (TID-16270) MUCOPOLYSACCHARIDES IN POST-IRRADIATION INTESTINAL ABSORPTION STUDIES. Lawrence E. Detrick (California. Univ., Los Angeles.

School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [1962]. Contract AT(04-1)-Gen-12. 21p.

A modified colloidal iron staining reaction in the intestinal acid mucopolysaccharide ground substance was one of the results of acute whole-body x irradiation. Capillary leakage and localized edema in the lamina propria were also observed. Such changes appeared early in the radiation syndrome and histopathological examination of the tissue indicated that repair was essentially completed by the fifth post-irradiation day. However, a secondary decrease in essential metabolite transport and absorption during the second post-irradiation week indicated that residual damage still existed. An electron microscopic examination of intestine cells showed that this defect was related to degranulation of the mast cells, swelling of the mitochondria and finally to the loss or lack of mitochondria in the intestinal epithelial cells. (auth)

25180 (TID-16271) ELECTRON MICROSCOPIC CHANGES ACROSS IRRADIATED RAT INTESTINAL VILLI. Lawrence E. Detrick, Harrison Latta, Harvey C. Upham, and Ruth McCandless (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [1962]. Contract AT(04-1)-Gen-12. 27p.

Morphological changes in irradiated rat intestinal villi were observed under an electron microscope. Neither thiamine transport nor the fine structure in the epithelium of the villi was significantly altered 1 hr or 1 day after 525 r whole-body x irradiation. Focal edema was observed. On the 3rd day after irradiation new abnormal epithelial cells appeared and thiamine transport was reduced. A partial recovery of intestinal thiamine on the 4th to 6th day after irradiation was not prevented by the reappearance of edematous changes and the development of microscopic hemorrhage. Sustained incomplete recovery of intestinal thiamine transport on days 10 to 17 was attributed to focal areas of epithelial degeneration. (C.H.)

25181 (TID-16317) GENETICAL INVESTIGATIONS ON THE EFFECT OF RADIATION ON HUMAN CELLS GROWN IN VITRO. Progress Report No. 1. Jan A. Boecek (Uppsala Univ. Inst. for Medical Genetics). Feb. 21, 1962. Contract AT(30-1)-2671. 9p.

Cell cultures derived from human fetal brain and lung tissue were irradiated. Doses varying from zero to 150 rads were applied and the effects measured by a determination of the frequency of post-metaphase chromosome aberrations. The most significant increase of post-metaphase aberrations occured after a dose of 22 to 23 rad and reached a high of 15 to 20% of the scored cells at a dose of 135 rad. Brief discussions are also given on investigations on associations between chromosome aberrations and pathological conditions in man, mongolism triploidy, and congenital heart malformations and chromosomal aberrations. (P.C.H.)

25182 (TID-16323) QUANTITATIVE POPULATION GENETICS OF MICE UNDER IRRADIATION. Progress Report, July 1, 1961 to June 30, 1962. Earl L. Green and Thomas H. Roderick (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). July 1, 1962. Contract AT(30-1)-1979. 21p.

Studies on the effects of low levels of gonadal irradiation, repeated generation after generation, on the genetic constitution of populations of mice and the genetic basis for differences in radiosensitivity of mice of different kinds are reported. Two groups of mice populations are being used. One group, called genetically homogeneous, is descended from a single pair of an inbred strain. The other group, called genetically heterogeneous, is descended from 4 pairs, one from each of 4 inbred strains, which were crossed to produce double-cross hybrids. It was found that genetic variability for resistance to irradiation in mice is extremely large. Other results, along with characteristics of the populations being studied as possible indicators of genetic damage, are also discussed. (P.C.H.)

25183 (UCD-105) THE EFFECTS OF X-RADIATION ON WORK CAPACITY AND LONGEVITY OF THE DOG. Annual Progress Report No. 11. A. C. Andersen (California. Univ., Davis. School of Veterinary Medicine). June 1962. Contract AT(11-1)-GEN-10. 271p.

Since this project has been operating for 11 years and the original beagle colony is approaching 9 years of age, aging syndromes in some dogs are a major concern. Surveillance of the aging dogs has been increased to 14 to 16 hr a day. Reproduction was not seriously affected by x radiation of female beagles. Data are included on the clinical status of the dogs, pathological conditions revealed at autopsy, detectable mammary neoplasms in irradiated dogs, and the incidence of cardiovascular disease in irradiated dogs. Major organ weights from normal beagles are tabulated in relation to age and as percent of body weight. Results of all studies to date are presented in detail, related to previous findings, and oriented around trends which indicate the directions that should be taken in future work. (C.H.)

25184 (SCL-T-424) PROBLEMS FACED BY THE HEMATOLOGISTS IN THE TREATMENT OF SUBJECTS IRRADIATED ACCIDENTALLY WITH A HIGH DOSE. Georges Mathé. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Rev. hématol., 15: No. 1, 3-9(1960). 11p.

The treatment of subjects exposed to high dose levels of radiation is discussed. A regime of strict rest, isolation from all infectious contacts, sterilized nourishment, and symptomatic treatment for states of anxiety and distress are recommended. An early evaluation of the radiation dose is urged. Signs of decompensation that demand energetic symptomatic treatment and the practice of administering bone marrow transfusions are discussed. (C.H.)

25185 THE INFLUENCE OF RADIUM ON THE OCULAR TISSUES OF THE RABBIT. III. ITS INFLUENCE ON THE CORNEA (SUPPLEMENT: THE INFLUENCE ON THE SCLERA). H. Mori (Kyoto Hospital). Acta Soc. Ophthalmol. Japan, 63: 1256-63(1959).

Clinical observations made on a series of cases radiated with doses of 100–5500 mg hr. The first sign of corneal affection was the appearance of a diffuse or punctate superficial keratitis. When the dose reached 3400 mg hr, excoriation appeared and at 5500 mg hr, an ulcer appeared. Histologically, the epithelial and the endothelial layers showed irregular arrangement of cells with vacuolation, and swelling with deformation of the nucleus. In some instances the epithelial layer became thinned. Especially in cases with ulcer, deformation or disappearance of the basal-cells and irregular distribution of the lines delimiting them from the lamina propria were observed. (Abstr. Japan Med., 2: No. 6, June 1962)

25186 THE INFLUENCE OF RADIUM ON THE OCULAR TISSUE OF THE RABBIT. IV. ITS INFLUENCE ON THE UVEA, RETINA AND OPTIC NERVE. H. Mori (Kyoto Hospital). Acta Soc. Ophthalmol. Japan, 63: 1264-8(1959).

In the iris, congestion, sometimes miosis, exudate, and hemorrhage were observed immediately after the first irradiation. The effects were transitory and disappeared rapidly. When the irradiation was repeated, aggravation and recurrence were not observed. The minimum destruc-

tive dose was 240–400 mg hr in full-grown rabbits and 100–160 mg hr in infantile rabbits; the latter were more susceptible than the former. Irradiation through the conjunctival sac had more influence on the eyes than through the palpebra; however, on radiation with a dose of more than 400 mg hr no difference between the two was seen. Histologically, cell infiltration in the iris and ciliary body and hemorrhages into the ciliary body were observed: there was no marked change in the retinochoroid. (Abstr. Japan Med., 2: No. 6, June 1962)

25187 THE INFLUENCE OF RADIUM ON THE OCULAR TISSUE OF THE RABBIT. V. ITS INFLUENCE ON THE LENS. H. Mori (Kyoto Hospital). Acta Soc. Ophthalmol. Japan, 63: 1269(1959).

In 9 cases of rabbits whose entire course was followed, cataract was observed which developed to total cataract during 3 years' observation. The destructive dose for the lens was approximately 200 mg hr in the infantile rabbit and approximately 500 mg hr in the full-grown rabbit. An opacity appeared initially on the lower part of the equator as a small vacuole. The developmental course was classified into 4 stages: appearance of a vacuole in the lower part of the equator; appearance and development of a vacuole and filamentous, punctate or cluster-like opacity in the cortex under the posterior capsule; appearance of opacity under the anterior capsule; and appearance of total cataract. Histologically, no characteristic findings were observed, but disturbance of the nuclear whorl, appearance of vacuoles under the anterior and posterior capsule and in the cortex, fragmentation and destruction of the fibers, accumulation of exudate, appearance of Morgagni's globules, and hypertrophy of the capsule were observed. The initial findings in the cataract seemed to be due to disturbances in the lens due to the direct effect of radiation. (Abstr. Japan Med., 2: No. 6, June 1962)

25188 PRODUCTION AND PROPERTIES OF HIGH ENERGY ELECTRONS FOR THERAPY. J. W. Beattie, K. C. Tsien, J. Ovadia, and J. S. Laughlin (Memorial Sloan-Kettering Cancer Center, New York). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 235–50(Aug. 1962).

The modification of a betatron for electron beam therapy is described. Topics discussed include circuits necessary for orbit contraction, beam monitoring, and energy control. The definition of fields with aluminum and lucite collimators is considered. Typical dose distributions produced as a function of energy, field size, angle of incidence, and wedging are presented. The combinations of different beams to obtain various resultant dose distributions are described. (auth)

25189 BETATRON: ELECTRON BEAM 10–35 Mev. CENTRAL DEPTH DOSES AND ISODOSE CURVES. Jack Spira, Charles Botstein, Benson Eisenberg, and Walter Berdon (Montefiore Hospital, New York). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 262–8(Aug. 1962).

Central depth dose and isodose charts are presented for an electron beam in the range 10 to 35 Mev produced by a 35-Mev betatron. (C.H.)

25190 A COMPARISON OF I^{131} ROSE BENGAL AND COLLOIDAL AU^{198} IN LIVER SCANNING. Godofredo Gomez Crespo, William J. MacIntyre, and James H. Christie (Highland View Hospital and Western Reserve Univ., Cleveland). Am. J. Roentgenol. Radium Therapy Nuclear Med., 88: 296–303(Aug. 1962).

The advantages and disadvantages of I^{131} rose bengal and colloidal Au^{198} in liver scanning are discussed. Results are reported of scans on normal individuals and patients with cirrhosis of the liver using both materials. Radioautograms showed that both materials were distributed uniformly in the liver of patients with cirrhosis. (C.H.)

25191 RADIOBIOLOGIC OBSERVATIONS ON HUMAN HEMIC CELLS IN VIVO AND IN VITRO. Edwin E. Osgood (Univ. of Oregon, Portland). Ann. N. Y. Acad. Sci., 95: 828–38(Nov. 13, 1961).

Published observations of 30-years study of the effect of ionizing radiation on human hemic cells in vivo and in vitro are outlined. Heretofore unpublished confirmation of Lajtha's concept of the synthetic period in the middle of the intermitotic period is presented. Further evidence that the effect of any agent either on cells in culture or in the body must be interpreted in the light of the concept of an ecology of cells is illustrated. The way in which the alpha cell-n cell concept of cell division in the multicellular organism clarifies the interpretation and understanding of radiation biology as well as cancer is explained. (auth)

25192 THE RESPONSE OF DROSOPHILA TESTIS TO X-RAY INDUCTION OF DOMINANT LETHALS. H. F. Hoenigsberg, L. V. Pozzi, and G. P. Sironi (Univ. of Milan). Atti assoc. genet. ital., 6: 261–76(1961). (CNEN-121). (In English)

Data are presented which suggest that to call a 3-day batch of sperms of Drosophila melanogaster as done in dosage-frequency experiments, an homogeneous sample is erroneous. A 9-day sensitivity spectrum includes all stages from mature spermatozoa to spermatocytes. The highest sensitivity to x rays is localized in the meiotic stage. In the oxygen effect there are two processes working independently from each other. These include the increase in the breakage of the chromosomes and an effect on the amount of rejoinings of the breaks. (auth)

25193 COMBINED EFFECTS OF X RAYS AND CHEMICAL MUTAGENS ON GROWTH OF NICOTIANA TABACUM. T. Cervigni and G. T. Scarascia (CNEN, Rome). Atti assoc. genet. ital., 6: 343–52(1961). (CNEN-118). (In Italian)

The effects of pretreatment in solutions of β-propiolactone, ethyl-methansulfonate, and ethylenimine on germination and survival of tobacco seeds irradiated with x rays are reported. From the variance analysis a simply additive effect was noticed for ethylenimine while for β-propiolactone and ethyl-methansulfonate an effect superior to the sum of the separate effects of the chemicals and x rays was found. Some of the possible causes of such synergism are discussed. (auth)

25194 EFFECTS OF RADIATION AND CHEMICAL MUTAGENS ON GROWTH AND SURVIVAL IN ITALIAN VARIETIES OF DURUM WHEAT. S. Avanzi (CNEN, Rome). Atti assoc. genet. ital., 6: 353–64(1961). (CNEN-124). (In Italian)

A study was made of the comparative effects of radiations (x-rays, thermal neutrons, fast neutrons) and of three chemical substances (β-propiolactone, ethylene chloride, diethyl sulfate) on seedling growth and plant survival in the field in the durum wheat varieties Aziziah, Cappelli, and Russello. It was found that both thermal and fast neutrons are able to inhibit root growth more strongly than shoot growth, while an almost identical degree of growth inhibition is observed in the two systems with x rays and chemicals. Maximum depressing effect was observed in the thermal neutron series. (auth)

25195 CHROMOSOME MUTATIONS INDUCED BY IONIZING RADIATION IN DURUM WHEAT (CAPPELLI). A. Bozzini (CNEN, Rome). Atti assoc. genet. ital., 6: 365–70(1961). (CNEN-126). (In Italian)

Among 13 R_3 morphological or chlorophyll radioinduced mutants of durum wheat (Cappelli), 3 progenies carrying a reciprocal translocation were found. Such chromosomic aberrations do not increase sterility. Translocation homozygous lines are now going to be obtained. Cytological investigations of abnormal R_4 plants showed a transmissible dicentric chromosome (2n = 28 + 1 dic.). Preliminary data concerning the mitotic behavior of the dicentric and fertility of the individuals are reported. (auth)

25196 MORPHOLOGICAL MUTATIONS INDUCED BY RADIATION IN DURUM WHEAT (CAPPELLI). G. T. Scarascia (Univ. of Pisa, Italy), F. D'Amato, and A. Bozzini. Atti assoc. genet. ital., 6: 371-80(1961). (CNEN-120). (In Italian)

Radiation-induced morphological mutations in the durum wheat variety Cappelli are described. Fifty-two mutations for single morphological characters were gathered. They appeared as single mutations per R_1 seed or as two and three contemporary independent mutations per R_1 seed. The mutations involved changes in the mode of tillering, leaf shape and size, wax cover, culm anatomy and morphology, and morphology of spike, glume, caryopsis. Of special interest are mutations for solid stem, fused-margin leaf, and defective endosperm. More than $^2/_3$ of the mutations appeared in thermal neutron experiments. (auth)

25197 VARIABILITY IN QUANTITATIVE CHARACTER AFTER IRRADIATION OF SEEDS IN TOMATOES. D. L. Palenzona (Università, Pavia, Italy). Atti assoc. genet. ital., 6: 381-94(1961). (CNEN-119). (In Italian)

In order to compare mutability by x rays with spontaneous mutability, dormant seeds of an autodiploid strain of Lycopersican pimpinellifolium were irradiated with 400 r. It was assumed that in this strain no genetic variability was present. The experiment was planned so that the effect of various types of selection could be estimated. A great amount of variability in plants from non-irradiated seeds was found. This result suggest that the assumption of complete homozygosity of autodiploid strains must be reconsidered. Intrasomatic, gametic, and zygotic selection effects have been found both in plants from irradiated and non-irradiated seeds, but their consequences are more striking in plants from irradiated seeds. The variability between plants within lines from irradiated seeds does not differ from that of lines from non-irradiated seeds, but this discrepance from expectation can be explained also by the different effect of gametic and zygotic selection on the two groups of plants. (auth)

25198 FIRST RESULTS ON THE SENSITIVITY TO X-RAYS OF THE ARTEMIA SALINA LEACH. P. Metalli, E. Ballardin, and C. Barigozzi (Università, Milan). Atti assoc. genet. ital., 6: 409-18(1961). (CNEN-117). (In Italian)

The radiosensitivity was determined of two stocks of Artemia salina, both of them amphigonic, but one predominantly diploid and the other predominantly tetraploid. The data reported refer to resistance to x rays of eggs in the dry stage and of two stages of larval development. It is concluded that radiosensitivity varies remarkably accordingly to ploidy. The predominantly tetraploid stock are more resistant than those belonging to the predominantly diploid stock. (auth)

25199 ELECTRON MICROSCOPIC OBSERVATIONS ON PRIMARY AND SERIALLY PASSAGED RADIATION-INDUCED MYELOID LEUKEMIAS OF THE RF MOUSE. D. F. Parsons, A. C. Upton, M. A. Bender, V. K. Jenkins, E. S. Nelson, and R. R. Johnson (Oak Ridge National Lab., Tenn.). Cancer Research, 22: 728-36(July 1962).

RF mice with primary and passaged radiation-induced myeloid leukemia were examined with the electron microscope for the presence of virus particles. The spleen, liver, and bone marrow of nearly all such mice examined contained small numbers of these particles. In one of two animals in which other tissues (thymus, pancreas, salivary glands, lymph nodes, omentum, lung, and brain) were examined, the thymus and pancreas also showed small numbers of particles. Much larger numbers of particles of the same morphology were seen in tissue cultures derived from the serially passaged leukemias. One control tissue culture, but none of the control tissues, contained similar particles. The particles resembled those associated with AKR mouse lymphoid leukemia (Type C in Bernhard's morphological classification of tumor viruses). Although cell-free filtrates of the particle-containing tissues have shown lymphoid and myeloid leukemogenic activity, the possible etiologic significance of the particles remains to be established. (auth)

25200 THE ROLE OF OXYGEN IN THE ACTION OF A RADIOMIMETIC AGENT (OXIDIZED OLEIC ACID) ON YEAST CELLS. Yu. B. Kudryashov and G. I. Gasanov (Moscow Univ.). Doklady Akad. Nauk S.S.S.R., 144: 443-5 (May 11, 1962). (In Russian)

Oleic acid at definite stages of oxidation has a very toxic effect on haploid and diploid yeast cells. The effect of oxygen on the radiomimetic action of oxidized oleic acid was followed by giving a dose of 10,000 to 100,000 r of Co^{60} gamma rays to haploid yeast cells (Zygosaccharomices bailii). Controls were unirradiated yeast cells to which no radiomimetic agent had been added, and also samples kept under a nitrogen atmosphere and in vacuum. The addition of non-oxidized oleic acid did not show any toxic effect. The toxic effect of the oleic acid peroxides was noticeably decreased by keeping the yeast cells under vacuum. A nitrogen atmosphere also decreased the toxic effect of the peroxides. Since a radiomimetic oxygen effect was detected, it is concluded that peroxides of fatty acids can be formed in the tissues of irradiated animals, and these toxic peroxides react with the biosubstrate to give symptoms of radiation sickness. (TTT)

25201 RADIATION CANCER: CANCER CAUSED BY IRRADIATION OF NON-MALIGNANT DISEASES OF THE NECK AND PHARYNX. H. Yamashita, S. Amino, M. Gomi, R. Matsuoka, T. Yasu, and Y. Kuroda (Cancer Inst., Tokyo). Gan no Rinsho, 7: No. 6, 361-8(1961).

A statistical analysis was made of 15 cases of so-called radiation cancer of the neck, which occurred following the irradiation of non-cancerous diseases (14 cases of tuberculosis of the lymph nodes and one hemangioma). The cancers which developed were 14 cases of squamous and one of adenocarcinoma. Although it was not confirmed that previous irradiations were the carcinogenic cause, the following characteristics were observed: after previous irradiation a relatively longer time (18–35 years) elapsed before the development of cancer. The irradiation dosage seemed to be more than several thousand roentgens, because the scar of skin induced by previous irradiations was clearly marked. The patients were generally younger than those with a spontaneously developed cancer. The lesions were already damaged by previous irradiation, resulting in atrophy, desiccation, pigmentation of the skin, and capillary dilatation. The prognosis was poor in all patients. (Abstr. Japan Med., 2: No. 6, June 1962).

25202 INFLUENCE OF RADIOACTIVE ISOTOPE P^{32} ON THE BLOOD, CELLS IN THE LYMPH AND BONE MARROW. II. THE INFLUENCE ON THE CELLS IN THE LYMPH AND BONE MARROW. N. Watabe (Hiroshima

Univ. School of Medicine). Hiroshima Igaku, 8: 3023-40 (1960).

Cells in the lymph and bone marrow pictures of 3-month-old rabbits were studied following the injection of 100 and 300 μc/kg and 1 mc/kg of P^{32}, respectively. The number of cells in the lymph changed parallel with the number of lymphocytes in the peripheral blood which recovered prior to the former's recovery. A mean value of mitochondria of lymphocytes in the lymph showed marked decrease immediately after the injection in all cases. The degeneration, destruction, and developmental disturbance of lymphocytes were evident, and their recovery became slow proportionately to the amount of P^{32}. These changes were almost parallel to changes of lymphocyte mitochondria in the peripheral blood. The neutrophilic red granules of lymphocyte in the lymph changed proportionately to the amount of administration of P^{32}; this change did not agree with a change of the neutrophilic red granules of the lymphocytes in the peripheral blood. The degree of damage to bone marrow was proportionate to the administered dose. The nuclear cell count was increased at 100 μc/kg, increased, after an initial decrease, at 300 μc/kg, and recovered, after a marked decrease, at 1 mc/kg. The leukocytic cell count recovered after gradual decrease at 1 mc/kg. The bone marrow and peripheral blood pictures were not always parallel. The differential count of the leukocytic cells showed a decrease in all 3 groups, but the young bone marrow cells were damaged severely. The promyelobiast was more sensitive than the myeloblast. (Abstr. Japan Med., 2: No. 5, May 1962).

25203 THE BEE AND RADIOACTIVITY. Claudy-Gabrielle Nordau. Inds. atomiques, 6: 75-84(1962). (In French)

A brief résumé is given of research done on the bee using radioisotopes. The labeling of the bee with radioactive gold, the radioresistance of the bee, the structure of the hive, and the food exchanges within the hive are the topics discussed. (J.S.R.)

25204 OXYGEN CONSUMPTION RATE IN THE BONE MARROW OF RADIATION-INJURED GUINEA-PIGS AND DRY BONE MARROW INJECTION. M. Kato (Juntendo Univ. School of Medicine, Tokyo). Juntendo Igaku Zasshi, 6: Nos. 3-4, 140(1960).

After a whole-body single x irradiation to adult guinea-pigs, the O_2 consumption rate in the bone marrow was definitely decreased. The rate recovered, with linearity of elapsed time. Thus the rate was adopted as an index of radiation injury and recovery. When the dried powder made of bone marrow of young rabbits was injected in heavily irradiated guinea-pigs, a significant recovery in the rate resulted. The hemoglobin value, red blood cells, and white blood cells, however, remained on insufficient level. Both the O_2 consumption rate and hematological counts were considerably improved when the dry bone marrow or dry lymph tissue extracted from adult pigs was injected. When human dry leukocytes were injected in heavily irradiated guinea-pigs, no effect was obtained. (Abstr. Japan Med., 2: No. 5, May 1962).

25205 STUDIES OF X-RAY HAEMATOPOIETIC INJURY WITH INTRAVENOUS INJECTIONS OF ISOTOPE Fe^{59}. T. Hinto (Juntendo Univ. School of Medicine, Tokyo). Juntendo Igaku Zasshi, 6: No. 6, 403-11(1960).

Young erythroblasts in the bone marrow of rabbits and dogs are more susceptible to the effects of radiation than either the leukocytes or blood platelets. (Abstr. Japan Med., 2: No. 5, May 1962).

25206 HISTOLOGICAL CHANGES IN SKIN TISSUES AND TISSUE MAST CELLS OF RATS AFTER IRRADIATION WITH ULTRASOFT RAYS AND THE EFFECT OF PRETREATMENT BY CYSTEINE OR GLUTATHIONE ON THEM. Y. Ohnuma (Juntendo Univ. School of Medicine, Tokyo). Juntendo Igaku Zasshi, 7: No. 1, 792-801(1961).

After investigating the distribution of mast cells in the skin and organs of normal rats, the effect of 2000 or 8000 r ultrasoft x radiation on the distribution of mast cells was studied. The number of mast cells in the skin decreased and then disappeared 3 to 5 days after irradiation by 2000 r, accompanied by a dilatation of the veins in the skin and atrophy of the hair roots. On irradiation by 8000 r, mast cells in the skin disappeared 3 days after the treatment, accompanied by atrophy of the subcutaneous adipose tissue. Intraperitoneal administration of 350 mg/kg of cysteine or 600 mg/kg of glutathione 5 to 60 minutes before irradiation prevented damage to the skin and a decrease in the number of mast cells. (Abstr. Japan Med., 2: No. 5, May 1962).

25207 CHANGE OF NUCLEIC ACID IN CHICK EMBRYO AFTER X- AND Co^{60} γ-IRRADIATION. K. Hongo (Keio Univ. School of Medicine, Tokyo). Keio Igaku, 37: 1753(1960).

DNA and RNA contents per one chick embryo irradiated were reduced as compared with the control group. The reduction degree was greater, when a larger dose was given. ED_{50} for DNA decreased with increasing age. When a chick embryo, younger than 12 days, was irradiated, a great reduction of RNA resulted. This reduction was smaller in embryos over 12 days old. (Abstr. Japan Med., 2: No. 5, May 1962).

25208 EFFECTS OF RADIATION ON NUCLEIC ACID IN VARIOUS ORGANS. S. Moriya (Keio Univ. School of Medicine, Tokyo). Keio Igaku, 37: 1921(1960).

DNA and RNA in the spleen and liver reached minimum quantity the second day after irradiation. For a decrease of DNA, Co^{60} γ rays were rather more effective than x rays, while RNA was more sensitive for an x ray effect. For RNA, the spleen was a little more sensitive for x rays than the liver. A recovery from reduction of DNA and RNA produced by Co^{60} γ rays was slightly more rapid than from that produced by x rays. (Abstr. Japan Med., 2: No. 5, May 1962).

25209 BREAKAGE AND ADHESION OF CHROMOSOMES INDUCED BY RADIATION. V. FREQUENCY OF CELL DIVISION IN EHRLICH'S ASCITES CANCER AFTER X-IRRADIATION. T. Yoshida and T. Takahashi (National Inst. of Genetics, Mishima, Japan). Kokuritsu Idengaku Kenkyujo Nempo, 10: 99(1960).

In a single whole-body x irradiation of small dose, the frequency of cell division in Ehrlich's ascites cancer was seen to increase temporarily immediately after irradiation, to decrease 8 hours, increase 12 hours later, and then to reach normal value. After irradiation with a large dose (1000 r) the frequency of cell division was considerably reduced immediately afterwards. (Abstr. Japan Med., 2: No. 5, May 1962).

25210 DOUBLING RADIATION DOSE IN GENETICS. Y. Yamada and O. Kitagawa (National Inst. of Genetics, Mishima, Japan). Kokuritsu Idengaku Kenkyujo Nempo, 10: 104(1960).

After giving 500, 1000, and 1500 r to drosophila the induced mutation rate was calculated from the regression. The estimation was $8.7 \times 10^{-5}/r$ for the number of abdominal hair, and $3.5 \times 10^{-5}/r$ for the number of chest hair. The doubling doses were estimated as 60 r for the

former and 30 r for the latter. (Abstr. Japan Med., 2: No. 5, May 1962).

25211 THE EFFECTS OF S-β-AMINOETHYLISOTHIURONIUM (AET) ON GENETIC DEATH DUE TO RADIATION. T. Sugawara and Y. Takeda (National Inst. of Genetics, Mishima, Japan). Kokuritsu Idengaku Kenkyujo Nempo, 10: 119(1960).

No effect of AET was found in the number of luteinization, imbedding, and living fetus in 14 days' pregnant mice, mated with a male irradiated by 500 r x rays in the testis 30 minutes after peritoneal administration of AET. (Abstr. Japan Med., 2: No. 5, May 1962).

25212 DIFFERENCE OF THE BIOLOGICAL EFFECT OF X-RAYS AND Co^{60} γ-RAYS ON THE METABOLISM OF NUCLEIC ACID IN ORGANS. G. Yamamoto. Kokuritsu Idengaku Kenkyujo Nempo, 10: 120(1960).

The biological effect of x ray single whole-body exposure on the metabolism of nucleic acid in the spleen of mice of the C_3H strain was larger than that of the same metabolism in mice irradiated by Co^{60} γ rays of the same dose with the same dose rate. No difference was detected, however, in the nucleic acid metabolism in the thymus and testis. When x rays were given with fractionated irradiation to the whole-body, the effect was generally greater than that of Co^{60} γ rays. (Abstr. Japan Med., 2: No. 5, May 1962).

25213 RADIATION EFFECT ON REPRODUCTIVE CELLS OF A RAINBOW-TROUT. Y. Harata and S. Kondo. Kokuritsu Idengaku Kenkyujo Nempo, 10: 126 (1960).

Radioresistance of rainbow-trout eggs is higher than that of sperms, as is the radiosensitivity of younger reproductive cells. 50% lethal dose is about 200 r. The impediment is not removed 2 months after irradiation. This high sensitivity of rainbow-trout to radiation indicates its appropriateness in the study of radiation biology. (Abstr. Japan Med., 2: No. 5, May 1962).

25214 STERILITY, STILLBIRTH, INFANT DEATH, AND SEX RATIO OF OFF-SPRINGS OF X-RAY WORKERS (ENGLISH TEXT). T. Kitabatake (Nagoya Univ. School of Medicine, Japan). Nagoya J. Med. Sci., 23: 227-37(1960).

Questionnaires were sent to 243 x-ray workers in Aichi Prefecture of Japan and 260 non-exposed controls. Primary sterility with statistical significance was seen in the exposed group more frequently than in the control. This is probably due to the large radiation dose received in the 2-year period before and after the marriage. Secondary sterility, stillbirth and abortion, infant death, and average number of children per person were about the same in both groups. (Abstr. Japan Med., 2: No. 5, May 1962).

25215 EYE ABNORMALITIES IN MOUSE EMBRYOS CAUSED BY X-IRRADIATION OF THE MOTHERS. CHANGES IN THE INITIAL STAGE OF DEVELOPMENT BY IRRADIATION ON THE 8th DAY OF PREGNANCY. (English Text). A. Majima (Nagoya Univ. School of Medicine, Japan). Nagoya J. Med. Sci., 24: No. 2, 85-95(1961).

Mice were exposed to a single whole-body x irradiation of 25 to 150 r on the 8th day of pregnancy. The embryos were removed on the 13th day of pregnancy and examined microscopically. Gross eye abnormalities ranged from microphthalmia to anophthalmia. The former were more frequent, and almost all were associated with abnormalities of the CNS. Microscopically, in those with extreme degrees of eye abnormalities, there were no cases believed to be primary anophthalmia. In hydrocephalic embryos, when the lumen of the optic stalk was wide and short, the optic cup was malformed and failed to reach the cranial subepidermis and in such cases the lens was also lacking. In some cases of exencephaly and allied conditions, the axis of the optic cup was directed vertically, and the optic cup opened, without a lens, directly into the mesenchymal tissue under the brain. In many abnormal eyes, the inner wall of the primordial retina was everted in the margin of the choroid fissure, and a cystic cavity was formed by the duplicated inner and outer walls. Such cases present changes quite similar to those seen in the development of hereditary uvea coloboma and bulbus cyst. (Abstr. Japan Med., 2: No. 6, June 1962)

25216 IMMEDIATE EFFECTS OF X-IRRADIATION ON THE HEART OF THE FROG. Cl. Onkelinx (Université, Liége). Nature, 195: 302(July 21, 1962).

The effects of whole-body irradiations on the heartbeat of pithed frogs were studied. A strong bradycardia was observed after 1 to 5 min of irradiation and is reversible within 1 min after irradiation. A sino-auricular block was observed in some cases. No response was found in any of the frogs during the cold months. The effects of atropine, physostigmine, and eserine on the response were studied. The results suggest a vagal excitation or acetylcholine liberation from the irradiation. (D.L.C.)

25217 SENSITIVITY OF INTERPHASE CELLS TO CHROMOSOME BREAKAGE BY X-RAYS. Nirmal K. Das and Max Alfert (Univ. of California, Berkeley). Nature, 195: 302-4(July 21, 1962).

Onion and bean root meristems were exposed to tritiated thymidine for 16 min, during the last 4 min of which they were irradiated with 200 r. The roots were then grown in water containing unlabeled thymidine and fixed at various times after irradiation. The frequencies of labeled ana- and telo-phases containing chromosomal aberrations were found to be much higher than the frequencies of unlabeled aberrant mitoses, indicating that cells in their DNA-synthetic phase (S) is most sensitive to x radiation. (D.L.C.)

25218 SEDIMENTATION STUDIES ON DNA FROM IRRADIATED E. COLI. P. K. Ganguli, S. B. Bhattacharjee, and N. N. Das Gupta (Saha Inst. of Nuclear Physics, Calcutta). Naturwissenschaften, 49: 215(1962). (In English)

In an attempt to study the effect of irradiation on DNA from irradiated E. coli, sedimentation studies on DNA extracted from normal and irradiated cells were done. The reciprocals of the sedimentation coefficients of DNA from control and irradiated E. coli with respect to water at 20°C were plotted as a function of concentration. The sedimentation coefficients for irradiated and controlled cells fall on the same curve. These results indicated that there was no change in the molecular weight of DNA from exposure to radiation up to 40 krads. (J.S.R.)

25219 STUDIES ON THE MECHANISM OF ULTRASONIC THERAPY, THE HEALING ACTION OF ULTRASONICS IN THE ANIMAL BODY. K. Ariga and K. Kobayashi (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 1: No. 2, 161-74(1959).

The thermal action of ultrasonic waves upon the tissues decreased steadily with advancing depth when the density of the tissues was homogeneous, but when the density was heterogeneous irregular strong heating occurred in some areas. Similar changes occurred in the time of temperature changes of tissues and organs during or after irradiation. Ultrasonics caused the temperature of the tissues to rise suddenly at first and then gradually, but soon after irradiation it fell, first abruptly and then slowly. The rise of temperature may be related to the amount of blood flow through the tissues. (Abstr. Japan Med., 2: No. 5, May 1962).

25220 INFLUENCE OF IRRADIATION OF Co^{60} NEEDLE ON YOSHIDA SARCOMA CELLS. H. Shimamura (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 19: 3185(1960).

Co^{60} needles were placed in the soft tissue of the abdominal wall of rats having Yoshida ascites sarcoma. When 8 mc of Co^{60} were set for 24 hours, the mitosis of sarcoma cells was definitely reduced more when radiation was given 1 to 2 days after the transplantation than when given 3 to 4 days after that. After irradiation, mitotic cells in the prophase decreased in the relatively early stage when radiation was given 1 to 2 days after the transplantation. The recovery from the injury also appeared considerably delayed. (Abstr. Japan Med., 2: No. 5, May 1962).

25221 THE ROLE OF THE TUMOUR BED IN THE GROWTH AND RADIOSENSITIVITY OF YOSHIDA ASCITES SARCOMA. T. Takahashi (Yokohama Univ. School of Medicine, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1844-68(1960).

No significant change in the development, growth, or radiosensitivity of Yoshida sarcoma was noted following 50 and 300 r whole-body x irradiation. A tendency towards increased tumor growth was observed after 600 r total or partial (abdomen) body x irradiation. The tumor growth was suppressed for 7 days after administration of LD_{50} doses of nitromin or thio-TEPA. The depression seen at 6 hours was considered to be a direct effect and that seen after 1 week an indirect effect. There was no significant change in radiosensitivity after administration of MLD doses. Significant changes in development, growth, and radiosensitivity of the tumor occurred, when anemia was induced in the host by lowering the hemoglobin from 100 to 60%. (Abstr. Japan Med., 2: No. 6, June 1962).

25222 STUDIES ON THE EFFECTS OF X-IRRADIATION UPON THE BLOOD PRESSURE OF RATS. G. Yoshii (Osaka Univ. Medical School). Nippon Igaku Hoshasen Gakkai Zasshi, 21: No. 5, 499-501(1961).

The blood pressure of rats was measured at 1 and 8 hours after a whole-body irradiation and also at 50 consecutive days. The doses given were 1000, 800, 700, 600, and 400 r at 250 kvp. All groups showed a rapid drop of blood pressure within 1 hour following irradiation. In the 600 r irradiated group, the blood pressure dropped again 2 or 4 days after irradiation which was considered to be caused by a different factor from that of the initial drop. (Abstr. Japan Med., 2: No. 5, May 1962).

25223 BIOLOGICAL EFFECT OF RADIATION ON BACTERIA. II. EFFECT OF X-IRRADIATION ON ENZYMES IN SAL. 57S. Y. Kanemasa (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 71: 6733(1959).

The ability to oxidize glucose and pyroracemic acid in bacteria was definitely decreased after x irradiation with 8000 r. Oxidation in the TCA cycle with α-ketoglutaric acid as the substrate was also disturbed. The disturbances were counteracted by the administration of cysteine. Oxidative phosphorylation also was decreased after x irradiation, as determined by observation of the P:O ratio and incorporation of P^{32} into Δ 7P. Nucleic acid was not influenced immediately after x irradiation. However, after incubation, DNA within the organism appeared to be decreased. (Abstr. Japan Med., 2: No. 5, May 1962).

25224 STUDIES ON CYTOTOXIN PRODUCED BY IRRADIATION. I. EFFECTS OF UNSATURATED FATTY ACID EXTRACTED FROM X-IRRADIATED RABBITS ON THE SUCCINIC ACID DEHYDRIC ENZYME SYSTEM IN THE LIVER OF NORMAL AND EHRLICH ASCITES CARCINOMA CELLS. M. Shioaki (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 72: 1203(1960).

The activity of succinic acid dehydric enzyme in normal liver tissue was definitely reduced by administration of unsaturated fatty acid extracted from x irradiated rabbits. The grade of reduction was approximately parallel to the concentration of unsaturated fatty acid given. In Ehrlich ascites mice, the activity of enzyme was rather a little increased immediately after the administration of extracted substance; however, the activity gradually decreased with the lapse of time. (Abstr. Japan Med., 2: No. 5, May 1962).

25225 INFLUENCE OF UNSATURATED FATTY ACID EXTRACTED FROM X-IRRADIATED RABBITS ON SUCCINIC ACID DEHYDRIC ENZYME ACTIVITY IN INTRAMUSCULARLY TRANSPLANTED YOSHIDA SARCOMA CELLS. Y. Iguchi (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 72: 1555(1960).

When the extracted substance from x irradiated rabbits (OX substance) was injected directly into the intramuscularly transplanted Yoshida sarcoma cells, the activity of the dehydric enzyme was reduced and very slowly recovered with the lapse of time. However, if OX substance were injected into normal muscular tissue near the tumor, the reduction of activity was quickly restored. Histochemically, large central necrosis, increased bionecrotic changes, and proliferative cell production was seen after injection of OX substance into tumor tissue. After the intravenous injection of OX substance, the enzyme activity in tumor tissue in which early necrotic change occurred increased considerably. (Abstr. Japan Med., 2: No. 5, May 1962).

25226 HAEMOLYTIC SUBSTANCE PRODUCED AFTER IRRADIATION. II. QUALITATIVE AND BIOLOGICAL STUDY ON HAEMOLYTIC SUBSTANCE. E. Akagi (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 72: 1561(1960).

Hemolytic substance extracted from irradiated liver was studied by the paper chromatographic method. Radiation anemia is mainly caused by biochemical changes activated after irradiation. Hemolytic substance seems to play an important role in this process. Its essential agent is considered to be lysolecithin. Lysolecithin produced in the body after x irradiation gave morphological changes in the hematopoietic system. (Abstr. Japan Med., 2: No. 5, May 1962).

25227 HAEMOLYTIC SUBSTANCE PRODUCED AFTER IRRADIATION. I. EFFECTS ON HISTOLOGICAL STRUCTURE OF HAEMOLYTIC PHOSPHOROUS FATTY SUBSTANCE EXTRACTED FROM THE IRRADIATED LIVER OF RABBIT. E. Akagi (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 72: 1261(1960).

After intravenous injection of hemolytic substance into healthy rabbits, the histological changes in the tissues were approximately the same as those produced by x irradiation. Therefore, hemolytic substance produced within the irradiated body, may have an influence similar to the radiation injury. Hemolytic anemia is considered to be one of the significant factors in hematological disorder due to irradiation. (Abstr. Japan Med., 2: No. 5, May 1962).

25228 EFFECTS OF OX SUBSTANCE ON THE MITOTIC PHASE AND DNA IN SUBCUTANEOUS YOSHIDA SARCOMA CELLS. Y. Iguchi (Okayama Univ. Medical School, Japan). Okayama Igakkai Zasshi, 72: 1269(1960).

When 0.2 ml of OX substance (unsaturated fatty acid extracted from x irradiated rabbits) was injected into subcutaneously transplanted Yoshida sarcoma tissue, reduction

of chromophile, loss of clarity of cell boundary, and increasing necrotic areas were observed histologically. About 6 to 12 hours after injection, the number of mitotic phases decreased, but recovered about 24 hours after injection. The quantity of DNA in cells was approximately parallel to the number of mitotic phases. (Abstr. Japan Med., 2: No. 5, May 1962).

25229 STUDIES ON VARIATIONS OF UNSATURATION OF LIPIDS IN SERUM BY THE EFFECT OF X-IRRADIATION. S. Amino (Osaka City Univ.). Ôsaka Shiritsu Daigaku Igaku Zasshi, 9: Suppl. No. 3, 3597-3608(1960).

Rabbits receiving a single dose of 1000 r showed a considerable decrease in the iodine number of the serum lipids 24 hours after irradiation. A gradual return to normal was seen in the surviving animals, but not in those that died. The decrease in iodine number was approximately parallel to changes in total fat and fatty acid levels. Less change was noted after irradiation with 300 to 500 r. Although the decrease in serum lipid iodine number after irradiation with 1000 r corresponded in degree to that of starving animals, it was not considered to be the result of starvation, but of abnormal fatty acid metabolism. (Abstr. Japan Med., 2: No. 5, May 1962).

25230 THE STUDY OF THE INTESTINAL ABSORPTION OF I^{131}-LABELED TRIOLEIN IN PATIENTS IRRADIATED WITH Co^{60} IN THE ABDOMINAL PELVIC REGION L. Dalla Palma, A. Miliani, M. Cappellini, and S. Citi (Univ. of Florence). Radiol. med., 48: 168-85(Feb. 1962). (In Italian)

Using triolein-I^{131}, the intestinal absorption of neutral fats in subjects irradiated with Co^{60} on the abdominal-pelvic region was studied. It was observed that in the large majority of cases the irradiation leads to impairment of the absorption. While this impairment appears only towards the end of the treatment in some patients, in others it appears half-way. In some of these latter subjects it tends to deteriorate while in others it regresses; finally, there is a limited number of patients in whom the absorption, which was altered at the start, improves on irradiation. In general, the intestinal absorption presents almost normal values approximately two months after the end of treatment. (auth)

25231 INFLUENCE OF ENERGY AND DOSE RATE ON THE RESPONSES OF RAT EMBRYOS TO RADIATION. Melvin R. Sikov and James E. Lofstrom (Wayne State Univ. Coll. of Medicine, Detroit and Detroit Memorial Hospital). Radiology, 79: 302-9(July 1962).

Rats at various stages of gestation were exposed to graded doses of x rays or gamma rays from 110 to 450 r, in both acute and protracted exposures. The animals were sacrificed after fourteen days of gestation and the results of the production of death and malformation in the fetuses. In general, it was found that a lesser effect was produced by gamma radiation than by physically equivalent doses of x rays. This usually resulted in RBE values in the accepted range (0.80 to 0.95), although substantially lower values (0.41 to 0.63) were found for anomalies of the head after irradiation at nine and a half days of gestation. There was also a reduction in the magnitude of some effects as well as increased values of RBE when protracted exposures were used. The clinical and theoretical importance of these differences are discussed. (auth)

25232 STUDIES ON THE COMBINED EFFECT OF ACTINOMYCIN D AND X-RADIATION. Ernest L. Schoeniger, Paul R. Salerno, and Hymer L. Friedell (Western Reserve Univ., Cleveland). Radiology, 79: 310-15(July 1962).

Experiments were conducted in tissue cultures to determine whether the combined effect of actinomycin D and x radiation is quantitatively greater than the theoretical sum of the effects produced by the same doses of each agent alone, as determined by the single agent response curve for a given combination of dosage fractions. Potentiation is said to be present when ½ dose A of an agent P + ½ dose B of an agent Q produces an effect greater than X, provided X is the effect of dose A of P and also of dose B of agent Q. This definition would apply also to any other combination of fractions of doses of agents P and Q whose sum is unity or less and whose effect is X or more. Potentiation according to the above definition was not demonstrated, as measured by cell or animal death in tissue cultures, mice, or rats. It seems that a different mechanism of toxicity operates in each agent and that the varying degrees of additivity observed are due merely to a numerical and biological alteration of the cell population by the agent first administered. When small doses of actinomycin D, which in themselves would not markedly alter the cell population were used, additivity with x rays could not be shown. It appears that, when enhancement of the combined effect occurs, it is only under conditions whereby each agent can effectively decrease the cell population. It can also be stated that the response curve for given increments of x ray dose is less in the presence of Actinomycin D. (auth)

25233 EFFECT OF CASEOPSIN ON RADIATION DAMAGE OF THE GONADS. S. Kitada (Tokyo Medical Coll.). Tokyo Ikadaigaku Zasshi, 18: Suppl. No. 5, 1901 (1960).

In a group of animals which had caseopsin administered prior to x irradiation, damage of gonads was only slight. However, radiation injury was moderate in mice when caseopsin was given after irradiation; the control animals showed moderate to considerable changes in the gonads. (Abstr. Japan Med., 2: No. 5, May 1962).

25234 EFFECTS OF HAEMATOPORPHYRIN Hg AND RADIATION ON GLYCOLYTIC ACTION IN HUMAN CANCEROUS TISSUE. S. Tokuoka and S. Shigetomi (Yamaguchi Prefecture Medical School, Ube, Japan). Yamaguchi Igaku, 9: No. 1 suppl., 178(1960).

Glycolysis was significantly decreased in the irradiated cancer of a patient when the hematoporphyrin, or its complex Hg salt, existed in the tissue. That was confirmed in 41 cases of gastric, 11 cases of uterine, and 7 cases of breast cancer. As for the histological type of the cancer, inhibition of the glycolytic action was seen most considerably in carcinoma simplex, and was lowest in squamous-cell cancer. The difference of values between these two was, however, less than 10%. (Abstr. Japan Med., 1: No. 5, May 1962).

25235 VLIYANIE IONIZIRUYUSHICHIKH IZLUCHENII NA FUNKTSII TSENTRAL'NOI NERVNOI SYSTEMY. (Effects of Ionizing Radiation on Functions of Central Nervous Systems). N. N. Livshits. Moscow, Publishing House of the Academy of Sciences, 1961. 180p.

A review is given of published data on the effects of ionizing radiation on functions of the central nervous system. The review covers in detail the literature published during 1954 to 1959. Extensive bibliographies are included. (R.V.J.)

25236 IONIZIRUYUSHCHEGO IZLUCHENIYA NA FUNKTSIYU VYSSHIKH OTDELOV TSENTRAL'NOI NERVNOI SISTERMY POTOMSTVA. (Effects of Ionizing Radiation on Functions of Higher Central Nervous System of Progeny). I. A. Piontkovskogo. Moscow, Medgiz, 1961. 210p.

Thirteen articles are included on physiological and morphological effects of radiation during embryonic development. The studies indicate considerable remote effects on the structure and functions of the higher control nervous system in animals. Separate abstracts have been prepared for twelve articles; one was previously abstracted in NSA. Extensive bibliographies are included. (R.V.J.)

25237 CERTAIN PECULIARITIES IN THE FUNCTION AND STRUCTURE OF THE CENTRAL NERVOUS SYSTEM IN ANIMALS EXPOSED TO IONIZING RADIATION DURING EMBRYONIC DEVELOPMENT. I. A. Piontkovskii. p.6-25 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

The influence of x and γ radiation on structural and physiological systems of adult animals exposed to ionizing radiation during embryonic development was studied in rats exposed to doses of 200, 150, and 50 r and in rabbits exposed to 200 to 300 r daily during the pregnancy period. The spontaneous locomotion activity and conditional reflexes were analyzed, and special electroencephalographic and general biological development were studied at various periods of development. Morphological, histological, and histochemical studies of the brains of animals exposed at various prenatal periods show extensive effects on the forming nervous system that disturb the metabolic processes during the postnatal period and early and late remote periods. (R.V.J.)

25238 CONDITIONED-REFLEX ACTIVITY OF WHITE RATS EXPOSED TO IONIZING RADIATION DURING THE PRE-IMPLANTATION STAGES OF EMBRYONIC DEVELOPMENT. V. E. Miklashevskii and M. B. Gol'dberg. p.26-44 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Radiation effects on gestation and the number of born progenies and their somatic and hematological characteristics were studied in 55 (29 control) white rats exposed to 200 r. Only 66.0% of the exposed animals delivered on time and the number of progenies was considerably smaller than for controls. However, no deformities were observed in the progenies. The irritation and active inhibiting equilibrium forces in exposed animals were retarded with insignificant deviations in conditioned reflex. (R.V.J.)

25239 CONDITIONED-REFLEX ACTIVITY OF WHITE RATS EXPOSED TO GAMMA RADIATION (Co^{60}) IN THE MIDDLE OF EMBRYONIC DEVELOPMENT. N. G. Mikhailova and V. E. Miklashev. p.45-61 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Conditioned reflex activity in white rats exposed to various types of radiation on the 12th day of antenatal development was studied. The results show a greater percentage of embryo destruction and deformities (of the skeleton and eyes) in progenies of irradiated animals. The conditioned reflex activity in progenies was also retarded. The disturbance of the nervous systems depends on the dosage received by the mother. (R.V.J.)

25240 ON CERTAIN PECULIARITIES OF THE HIGHER NERVOUS SYSTEM ACTIVITY IN RATS EXPOSED TO X RADIATION DURING THE SECOND HALF OF ANTENATAL DEVELOPMENT. I. A. Kolometseva. p.62-78 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Sistemy Potomstva." Moscow, Medgiz, 1961.

Leukopenia, loss of weight, delayed maturity, and retarded growth were observed in progenies of rats exposed to x radiation on the 18th day of embryonic development. Conditioned reflex activity shows increased emotion and quick exhaustion of basic nervous processes with disturbed locomotion and equilibrium. (R.V.J.)

25241 ACTIVITY OF THE HIGHER NERVOUS SYSTEM IN MATURE RATS EXPOSED DAILY TO X RADIATION DURING EMBRYONIC PERIOD. V. N. Semagin. p.79-101 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Radiation effects on the higher nervous system of mature rats exposed during embryonic development to daily doses of 10 and 1 r were analyzed. The results show in about 4 to 8% of the cases deformities, increased fatality at early postnatal periods, and increased morbidity. An increased motor activity was observed during the third postnatal week. Doses of 10 r show somewhat greater effects than 1-r doses. The conditioned reflex indicates decreased excitation in mature animals. Equilibrium and locomobility are also disturbed. Smaller absolute and relative weight of the brains and thinner cortex were also observed in rats chronically exposed during prenatal periods. (R.V.J.)

25242 ON CERTAIN PECULIARITIES OF UNCONDITIONED AND CONDITIONED REFLEX ACTIVITY IN THE ONTOGENESIS IN IRRADIATED RABBITS DURING EMBRYONIC PERIOD. R. I. Kruglikov. p.102-13 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

The peculiarities of unconditioned and conditioned reflex activity in ontogenesis in rabbits exposed to 400 r antenatal irradiation during the 23rd day of embryogenesis were studied. The results indicate a general depression in postnatal development and disturbance of the higher central nervous system with retarded development of cerebral hemisphere cortex and metabolic deficiency in cortical and subcortical matter. (R.V.J.)

25243 ELECTROENCEPHALOGRAM OF IRRADIATED RABBITS DURING LATE EMBRYOGENESIS. A. M. Ivanitskii. p.128-40 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Electroencephalograms of mature rabbits irradiated with 300 r on the 23rd day of embryonic development indicate disturbances in the nervous system and especially in the cerebral cortex. (R.V.J.)

25244 INVESTIGATIONS OF INTRACENTRAL RELATIONSHIP IN THE BRAIN OF RABBITS EXPOSED TO X RADIATION DURING EMBRYOGENESIS. A. M. Ivanitskii. p.141-55 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Experiments with adrenaline injections in mature rabbits irradiated during middle and late embryogenic periods exhibited electroencephalographic changes similar to the awakening reaction and indicated a strongly increased sensitivity to adrenaline caused by disturbances in the reticular system. (R.V.J.)

25245 STRUCTURAL CHANGES IN THE CENTRAL NERVOUS SYSTEM IN RATS EXPOSED TO X RADIATION DURING EMBRYOGENESIS. N. I. Artyukhina. p.156-72 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Irradiation with 200 r on the 18th day of pregnancy destroyed the embryo epithelium and surrounding neuroblasts, resulting in underdeveloped upper (2 to 4) layers of cerebral hemisphere cortex (especially in dorsomedial re-

gions). All irradiated animals exhibited delayed development of the cerebral cortex and brain. (R.V.J.)

25246 HISTOPATHOLOGICAL CHANGES IN CENTRAL NERVOUS SYSTEM IN WHITE IRRADIATED RATS DURING THE LATE PERIODS OF EMBRYOGENESIS. M. M. Aleksandovskaya. p.173-84 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Delayed development of the cerebral cortex, corpus callosum, Ammon's horn, and stratum were observed in progenies of pregnant rats exposed to 200 r of γ rays. It is postulated that morphological changes in prenatally irradiated animals are related not only to the direct effects of ionizing radiation on the nervous and gliosis cells (neuroblasts and spongioblasts) of the early ontogenesis but also to the toxic-anoxic and metabolic changes in various structural tissues in the brain. (R.V.J.)

25247 MORPHOLOGICAL CHANGES IN THE CEREBRAL CORTEX AND SUBCORTEX IN MATURE RABBITS EXPOSED TO X RADIATION DURING THE ANTENATAL PERIOD OF DEVELOPMENT. I. A. Chernyshevskaya. p.185-91 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

Morphological studies of cortex and subcortex in year-old rabbits exposed to 400 r of x radiation on the 15th day of embryogenesis show underdeveloped cerebral cortex, corpus callosum, and cerebellum and enlarged ventricles of the brain with hydrocephalin signs in some animals. Microscopic studies revealed deep distrophic cortex changes with cytoarchitectonic and layer stratification disturbances and contracted and destroyed cells, especially in the deep layers of the cortex. Hydropic changes of nerve cells were found ventral-medial and dorsomedial. (R.V.J.)

25248 CHANGES IN PERIPHERAL BLOOD OF RATS EXPOSED TO IONIZING RADIATION DURING ANTENATAL PERIOD OF DEVELOPMENT. M. B. Gol'dberg. p.192-201 of "Ioniziruyushchego Izlucheniya na Funktsiyu Vysshikh Otdelov Tsentral'noi Nervnoi Sistemy Potomstva." Moscow, Medgiz, 1961.

A blood analysis was made of 1-, 2-, 7-, 14-, 21-, and 31-day-old progenies of three groups of rats exposed to 200 r of x radiation on the 5th, 12th, and 18th day of embryogenesis, respectively. All exposed mother rats suffered from leukopenia. A higher hemoglobin content in comparison to controls was found in day-old rats exposed to x radiation during the 5th day of embryogenesis. However, during the following days (up to 150 days) the difference in the hemoglobin content disappeared. The number of hemoglobin, erythrocytes, and leukocytes was higher in the group exposed on the 12th day of embryogenesis, but at later dates the number of hemoglobin and erythrocytes leveled off and was identical to the controls. Symptoms of anemia and leukopenia at birth, with more acute forms on the 7th day, were observed in the group exposed on the 18th day of embryogenesis. At later dates the content of hemoglobin and erythrocytes increased but never reached the level in control animals. (R.V.J.)

Radiation Sickness

25249 (NP-11740) POTENTIAL ANTI-RADIATION COMPOUNDS. Interim Technical Report No. 5. F. Ivy Carroll and Monroe E. Wall (Research Triangle Inst., Durham, N. C.). June 1, 1962. Contract DA-49-193-MD-2164. 9p.

The preparation of aliphatic secondary or tertiary thiol-primary amino-hydrochlorides and similar derivatives from cyclic ketones with 7, 6, 5, and 4 membered rings is summarized. A brief discussion is also given on compounds containing functional groups in addition to SH and NH_2. An evaluation of the Parham-Ramp procedure for the synthesis of aliphatic compounds is included. (P.C.H.)

25250 (NP-11753) INVESTIGATIONS ON THE PROBLEM OF FORMATION AND PATHOPHYSIOLOGICAL SIGNIFICANCE OF BIOGENIC AMINES IN SUBLETHAL RADIATION INJURIES. Quarterly Technical Status Report No. 2, February 1–April 30, 1962. Fr. Franzen (Cologne. Universität. Medizinische Klinik). May 30, 1962. Contract DA-91-591-EUC-1978. 3p.

Rats exposed to a single whole-body dose of radiation showed a significant increase in biogenic amines. Cutaneous application of an amine formation inhibitor, phenylacetic acid, immediately after radiation exposure reduced the daily measured excretion of amines. The effects of biogenic amines on gaseous metabolism during the radiation syndrome were also investigated. The microscopic examination of living cells showed that amines caused contraction of arteries and arterioles that led to a stasis of the vessel content. (C.H.)

25251 (TID-16159) TECHNICAL PROGRESS REPORT [ON RADIOPROTECTIVE AGENTS], APRIL 1, 1961 TO MARCH 31, 1962. (Colorado. Univ., Denver. School of Medicine). Contract AT(11-1)-394. 7p.

Progress is reported in studies on the effects of mercaptoethylguanidine and its disulfide on synthesis of macromolecular components in irradiated cells, the effects of monamine oxidase inhibitors on the protective action of serotonin against radiation injuries in mice, the exploration of the protective effects of sulfhydryl compounds related to serotonin against radiation injuries, the effect of serotonin on the incorporation of adenine-C^{14} and glycine-C^{14} in HeLa cells, the effects of parathyroid extract on radiosensitivity in rats, and the preparation of urinary cancer antigens. (C.H.)

25252 (TID-16160) CHEMICAL PROTECTION OF MICE FOLLOWING TOTAL BODY X-IRRADIATION. Edward D. Coen and Richard W. Whitehead (Colorado. Univ., Denver. School of Medicine). [1961]. Contract AT(11-1)-394. 9p.

Male Swiss strain mice were x irradiated with 700 r and then given various radioprotective agents. 5-OH tryptophan, serotonin, and several monoamine oxidase (MAO) inhibitors were tested. Propylene glycol was used as a solvent for one MAO inhibitor, α-dimethylamino-1-ethyl-3-indolemethanol. All drugs were only moderately protective when given 1 hr before radiation. (P.C.H.)

25253 EXPERIMENTAL STUDY ON CHEMICAL PROTECTIVE AND THERAPEUTIC AGENTS AGAINST RADIATION INJURY. K. Kojima (Kyushu Univ. Faculty of Medicine, Fukuoka, Japan). Igaku Kenkyu, 30: 3820(1960).

Various chemical agents were administered to mice before or after whole-body x irradiation of 550 r. Lethality and hematological findings were examined. Cystine, cysteamine, homocysteine thiolacton, methylmethionine, sulfonium chloride, alinamine, thioctic acid, glucuronic acid, and tranquillizers had a protective and therapeutic effect for radiation injury. However, glutathion, L-methionine, thiolactic acid, pantothenic acid, vitamin B_{12}, orotic acid, vitamin B_4, and nucleic acid were less or not effective. (Abstr. Japan Med., 2: No. 5, May 1962).

25254 EFFECT OF RADIATION ON BIOLOGICAL SYSTEMS. III. BIOLOGICAL PROTECTORS. P.-E. Pilet

(Universite Lausanne, Switzerland). Inds. atomiques, 6: 71-4(1962). (In French)

The first studies made in this field are briefly reviewed. Tests devised to measure protective effects and the units used to express the results are described. Some of the most characteristic compounds used as radioprotectors are examined, and the theories developed to interpret the results are summarized. (J.S.R.)

25255 EFFECTS OF PROTECTION AGENTS AGAINST RADIATION INJURY ON INJURIES IN NUCLEIC ACID METABOLISM IN THE ORGANS. G. Yamamoto (Izu-Teishin-Byoin, Shizuoka, Japan). Kokuritsu Idengaku Kenkyujo Nempo, 10: 121(1960).

When MEA (mercaptoethylamine) or AET (aminoethylisothiuronium) was given to mice prior to x irradiation, nucleic acid metabolism in the organs was not injured. However, the grade of protection may be related to the toxicity of these substances. The protective grade in nucleic acid metabolism in the thymus, spleen, and testis was approximately parallel to the effect on lethal rate of mice. In the spleen only, the administration of MEA or AET was effective for protection of nucleic acid metabolism even after irradiation. (Abstr. Japan Med., 2: No. 5, 1961).

25256 EFFECTS OF CHEMICAL AGENTS AGAINST RADIATION INJURIES. I. CLINICAL EXPERIENCE WITH A WATER-SOLUBLE ADRENOCHROME PREPARATION (AC-17). [PART] I. S. Izome and F. Tagaya (Univ. of Tokyo Faculty of Medicine). Kyobu Shikkan, 5: No. 1, 89-92(1961).

Patients with post operative breast cancer received 100 mg of AC-17 intraveneously every other day during radiotherapy. The control group was chosen from patients not treated by radiation. Moist radiodermatitis occurred in 18 to 60% of control patients; only 12.5% of the patients injected with AC-17 showed slight skin changes. In the AC-17 injected group, the grade of leukopenia was only small, but the control group showed definite leukopenia. The incidence of pulmonary injury was about the same in the two groups; however, the area size of pulmonary injury was smaller in the AC-17 injected group than in the controls. In conclusion, AC-17 seems to be effective treatment for radiation injury. (Abstr. Japan Med., 2: No. 5, May 1962).

25257 EFFECTS OF OROTIC ACID ON RADIATION INJURIES. T. Miyasaka and M. Shinno (Keio Univ. School of Medicine, Tokyo). Naika No Ryoiki, 8: No. 7, 424(1960).

Orotic acid administration was more effective on the anemia, leukopenia, or reduction of serum albumin induced by radiation in rabbits when given after irradiation, than when given before. The acid may also be of value for prevention and treatment of hematological disorders induced by radiation. (Abstr. Japan Med., 2: No. 5, May 1962).

25258 PROTECTIVE EFFECT OF CYSTEINE AGAINST THE REDUCTION OF ANTI-INFECTIOUS MECHANISMS PRODUCED BY MASSIVE X-IRRADIATION. T. Nagoshi (Nihon Univ. School of Medicine, Tokyo). Nichidai Igaku Zasshi, 19: 1324(1960).

Resistance against infection was distinctly reduced in mice after whole-body x irradiation of 500 to 600 r. However, when 2.5 mg of cysteine was administered intraperitoneally 30 min prior to x irradiation and S. typhimurium was introduced into the body of mice perorally 3 days after the irradiation, the number of positive findings in the intestinal lymph nodes, liver, spleen, and peripheral blood decreased. It was concluded that cysteine is effective for countering diminution of anti-infectious capacity particularly when administered before x irradiation. (Abstr. Japan Med., 2: No. 6, June 1962)

25259 "MARZINE" IN THE TREATMENT OF RADIATION SICKNESS. Władysław Jasiński, Jerami Swiecki, and Danuta Gajl. Polski Przealad Radiol. i Med. Nuklearmej, 26: 237-9(1962). (In Polish)

Marzine proved to be very effective in radiation sickness especially in cases suffering from nausea and vomiting. The compound was used in 15 patients; 50-300 mg were given daily. In 11 patients the symptoms of sickness ceased completely; in 3 patients out of 15 the symptoms were alleviated, and one patient did not respond. Response to the drug was prompt and complete. It is felt that in many cases the application of this drug could complete the treatment. The only side effect, vertigo, appeared in one patient, but his general condition was not impaired. (auth)

CHEMISTRY

General and Miscellaneous

25260 (JAERI-1029) MOCK-UP TEST OF JUNIOR CAVE FOR CHEMICAL PROCEDURES. Tokutaro Matsumoto, Satoru Emura, and Tadashi Yamamoto (Japan Atomic Energy Research Inst., Tokyo). 1962. 29p. (In Japanese)

A facility for the rapid routine analysis of reprocessing plant samples and the development of new analytical methods dealing with highly radioactive samples is described. It consists of ten analytical junior caves, several glove boxes, cold preparing area, counting room, decontamination room, and shower room. Shielding of the cave will be provided with 15 cm thick lead at the operating face and 20 cm steel at the back wall. The lead glass window and pairs of ball socket manipulators with equivalent shielding ability to the wall will be set in the operating face of each cave. The internal dimensions of each cave are $1.0 \times 1.1 \times 1.4$ m high. Operations such as sample loading storage, pipetting, dilution, density measurement, pre-treatment, titration, polarography, coulometry, etc. will be carried out in these junior caves. The following problems which were required for design were tested in full scale mock-up: visual field, illumination, operatable area of manipulators, working space, and dimensions of junior cave. (auth)

25261 (JPRS-13785) THE SECOND ALL-UNION CONFERENCE CONCERNING ISOTOPES IN CATALYSIS. S. Z. Roginskii (Roginskiy). Translated from Kinetika i Kataliz, 2: 643-7(Sept.-Oct. 1961). 8p.

Papers presented at the Second All-Union Conference on Isotopes in Catalysis are reviewed. Topics covered include isotopes in the research of solid catalysts, kinetic isotope effects in heterogenous catalysis, and the mechanism of heterogenous catalytic reactions. (M.C.G.)

25262 THE CRYSTAL STRUCTURE OF BIS(m-BROMOBENZOYL)METHANE. Donald E. Williams, Warren L. Dumke, and R. E. Rundle (Ames Lab., Ames, Iowa). Acta Cryst., 15: 627-35(July 10, 1962). (IS-295)

The crystal structure of bis(m-bromobenzoyl)methane was determined, and the three dimensional scintillation counter data refined by anisotropic least squares. The molecule is nearly planar, with a maximum deviation of 0.12 Å from the least squares plane, and is tilted in the unit cell ± 29.9° from the (010) plane. The molecule has a short intramolecular hydrogen bonded distance of 2.464 ± 0.015 Å, but the thermal parameters suggest an anomaly. Symmetry requires complete equivalence of the two C–O groups and the intervening C–C bonds of the enol ring, and the thermal parameters support the interpretation that this equivalence is real rather than statistical. (auth)

25263 PROCESS FOR PRODUCING AND RECOVERING ORGANIC NUCLEAR REACTOR COOLANT-MODERATORS. (to U. S. Atomic Energy Commission). British Patent 901,684. July 25, 1962.

A process is outlined for converting damaged polyphenyl reactor coolants with high molecular weight residues into lower molecular weight polyphenyls for reuse as reactor coolants. The process comprises hydrogenating the residues under pressure, at high temperatures, and in the presence of a catalyst. The catalyst preferably is Al_2O_3 with a minor proportion of CuO, for maximum ring cleavage with minimum ring hydrogenation. (D.L.C.)

Analytical Procedures

25264 (ANL-6577) A GENERALIZED PROCEDURE FOR THE ISOLATION OF IODINE WITHOUT CARRIER—ITS DETERMINATION BY NEUTRON ACTIVATION USING I^{129} AS AN ISOTOPIC TRACER. Martin H. Studier, Clarence Postmus, Jr., Joseph Mech, Robert R. Walters, and Eric N. Sloth (Argonne National Lab., Ill.). July 1962. Contract W-31-109-eng-38. 10p.

In order to make the 1.7×10^7-year I^{129} useful as an iodine tracer, a neutron-activation procedure was used for its determination. A procedure involving high-temperature ignition in a stream of oxygen was devised for the isolation of iodine from a variety of materials. After activation and decontamination, a large sodium iodide, well-type crystal was used as a selective detector for the I^{130} activation product. The normal iodine content of a sample is readily determined at the same time. (auth)

25265 (BLG/B-4) CHROMATOGRAPHIE SUR PAPIER. VALEURS DES Rf DU TELLURE IV ET DU TELLURE VI. (Paper Chromatography. Rf Values for Tellurium(IV) and Tellurium(VI). R. Stiennov-Bovy and G. Geladi (Brussels. Centre d'Etude de l'Energie Nucléaire). Mar. 15, 1962. 7p.

Values published for the Rf of tellurium(IV) and tellurium(VI) in different solvents are given. So far as possible, experimental conditions are specified. (auth)

25266 (CNEN-135) SEPARAZIONE E DETERMINAZIONE SPETTROFOTOMETRICA E SPETTROGRAFICA DI TERRE RARE IN COMPOSTI DI URANIO. (Separation and Spectrophotometric and Spectrographic Determination of Rare Earths in Uranium Compounds). W. Barbieri, C. Stoppa, and L. Lorenzini (Italy. Comitato Nazionale per l'Energia Nucleare. Divisione Materiali, Rome). Apr. 1962. 28p.

After the extraction of Uranium with 0.5M TIOA in xylene from strong chloride solutions, two methods are proposed to isolate the rare earths elements from other interfering ions: extraction of lantanides by employing TTA in xylene at 60°C; and chromatography on anionic resin sulfuric solutions. The rare earths are determined altogether by a spectrophotometric procedure using arsenazo. In controlled atmosphere it is possible to carry out a quantitative spectrographic determination arcing the fluorides. The procedure for the determination of Gd, Sm, Dy, and Er is described. (auth)

25267 (IA-724) THE DETERMINATION OF SMALL QUANTITIES OF TELLURIUM IN THE PRESENCE OF VERY LARGE QUANTITIES OF BISMUTH. S. Goren, M. Mantel, and M. Stiller (Israel. Atomic Energy Commission, Tel Aviv). May 1962. 18p.

A spectrophotometric method for the determination of small quantities of tellurium in the presence of very large quantities of bismuth, up to 1 : 3000, without prior separation of the latter, is described. A tellurium sol is prepared by the reduction of Te(IV) to metallic tellurium by stannous chloride in hydrochloric acid solution in the presence of gelatine. The absorption of the tellurium sol was measured at λ = 400 mμ with an accuracy of 3%, a sensitivity of 0.48 λ/cm^2 and a limit of detection of 0.2 λ Te/ml. Optimal working conditions, including acidity, stannous chloride concentration, stability of sol and suit-

able wavelengths, and also maximum permissible concentration of bismuth, were determined. (auth)

25268 (JAERI-4020) ANALYTICAL PROCEDURES OF URINE FOR RADIONUCLIDES. A Bibliography. Jun Akaishi (Japan Atomic Energy Research Inst., Tokyo). [1961]. 45p. (In Japanese)

References (150) are given to papers published since 1950. (P.C.H.)

25269 (NP-11834) RECOMMENDED METHODS OF THE PANEL ON METHODS OF ANALYSIS. Information Bulletin No. T8, Part III. (Watertown Arsenal, Mass.). June 8, 1962. 48p.

Methods are described for analysis of Ti alloys. Included are an ion-exchange-cupferron gravimetric method for Nb and Ta in the range 0.25 to 5.0%, a hot extraction method for H in the range 5 to 1000 ppm, an inert-gas fusion method for O in the range 0.03 to 0.2%, and a vacuum fusion (Pt-flux technique) for O in the range 0.03 to 0.5%. The vacuum fusion method can also be used for H. (J.R.D.)

25270 (PG-Report-330) ANALYTICAL METHOD FOR THE GRAVIMETRIC DETERMINATION OF SULPHATE IN URANYL NITRATE LIQUORS AND URANIUM TRIOXIDE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1962. 5p.

The sample is converted to uranyl chloride, and the sulfate, precipitated as barium sulfate from an aqueous/acetone medium, is granulated by controlled removal of acetone, ignited, and weighed. (auth)

25271 (TID-16156) THE APPLICATIONS OF ISOTOPES TO INDUSTRIAL PROBLEMS. Progress Report Letter No. 39, May 15 to June 15, 1962. Foster F. Rieke (Chicago. Univ. Labs. for Applied Science). June 22, 1962. Contract AT(11-1)-712. 5p. (LAS-L-161-46)

Progress is reported in the development of a neutron moderation process for the determination of the moisture content of coal in large storage piles. Results of several calculations are tabulated. A survey was made of possible α sources for use in chemical analysis by Rutherford scattering. (C.H.)

25272 (TID-16332) ANALYTICAL CHEMISTRY AT LOW CONCENTRATIONS. Sixth Annual Report. John T. Stock (Connecticut. Univ., Storrs). July 28, 1962. Contract AT(30-1)-1977. 30p.

The possibility of accurate amperometric titration of low concentrations of nitrite ion with potassium permanganate was confirmed. Difficulties encountered in the rapid microdetermination of mercury in the presence of ethylenediamine also appear to have been overcome. A simple automatic potentiometric titrator was brought to the stage where setting-up and operation are straightforward. Work on the preparation, polarography, and use in amperometric titration of quinoline derivatives is described. A promising method for the determination of microgram quantities of chloride was also developed. This involves the electrolytic deposition of chloride on a mercury microelectrode, followed by cathodic stripping. (auth)

25273 (UCRL-6873) CHEMICAL ANALYSES OF PLUTONIUM AND PLUTONIUM ALLOYS: METHODS AND TECHNIQUES. A Literature Search Covering the Period 1950–July 1961. Rose Kraft, Carl Wensrich, and Arthur L. Langhorst, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 11, 1962. Contract W-7405-eng-48. 34p.

References (355) are given to books, periodicals, and reports published from 1950 to July 1961. A subject index (Keyword-In-Context) prepared on the IBM-1401 by the arrangement in alphabetical order of key words within the title and those appearing in parentheses below the title is included. The index is believed to aid in the location of specific information by the use of words that appear within the title of a publication. (P.C.H.)

25274 (Y-1394) FLAME PHOTOMETRIC DETERMINATION OF SODIUM AND POTASSIUM IN BERYLLIUM METAL. R. E. Barringer (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). May 1, 1962. Contract W-7405-eng-26. 22p.

A flame photometric method was developed to determine the amount of sodium and potassium in beryllium metal. Concentrations greater than 10 μg of sodium and 100 μg of potassium per gram of beryllium can be determined with a minimum of sample preparation. A specially designed hood and scrubber system was provided for the control of hazardous materials from the burner exhaust gases. (auth)

25275 (AEC-tr-5194) MICROSCOPIC ANALYSIS. CHIEFLY RELATING TO INORGANIC SUBSTANCES. Toshio Sudo. Translated from Bunseki Kagaku, 11: No. 1, 140–7(1962). 15p.

Microscopic analysis of inorganic materials is discussed. The history of its development, chemical microscopy, apparatus, and procedures are described. The most important chemical reactions used in microscopic analysis are listed. A systematic procedure for analysis is presented. (M.C.G.)

25276 (AEC-tr-5250) ON THE QUALITATIVE DETERMINATION OF VANADIUM. M. A. Popov. Translated by Stephanie M. Sydoriak (Los Alamos Scientific Lab., N. Mex.) from Zavodskaya Lab., 13: 680–2(1947). 4p.

Methods for the qualitative determination of vanadium using aniline, benzidine, or α-naphthylamine are given, and an evaluation of each is presented. (P.C.H.)

25277 (AEC-tr-5251) A METHOD OF DETECTING PLUTONIUM BY GAMMA SPECTROGRAPHY AT 17 kev: APPLICATION OF MEASUREMENT OF RADIOACTIVE CONTAMINATION IN MAN. M. Trouble. Translated from p.237–41 of "Proceedings of the Symposium on Selected Topics in Radiation Dosimetry, held in Vienna, June 7–11, 1960." (a publication of the International Atomic Energy Agency, Vienna, 1961. (STI/PUB/25(p.237–41)). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 26007.

25278 (SCL-T-423) SEPARATION OF CHEMICAL ELEMENTS. Branca Edmee Marques and Maria Regina Grade. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Ciencias (Madrid), 21: 405–11 (1956). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 159.

25279 APPLICATION OF STRIPPING ANALYSIS TO THE DETERMINATION OF IODIDE WITH SILVER MICROELECTRODES. Irving Shain and S. P. Perone (Univ. of Wisconsin, Madison). Anal. Chem., 33: 325–9(Mar. 1961).

The extension of stripping analysis to the determination of halides with a silver microelectrode was investigated. During the preelectrolysis step, a portion of the halide was deposited by a controlled potential oxidation of the silver electrode. Two methods of stripping the silver halide deposit from the electrode were investigated: electrolysis with constant potential, and electrolysis with linearly varying potential. The quantity of electricity measured in the stripping step was a direct function of the preelectrolysis time and the bulk concentration of halide. The method was applied to iodide solutions as dilute as 4×10^{-9} M. (auth)

25280 ANION EXCHANGE RESIN SEPARATION OF THE RARE EARTHS, YTTRIUM, AND SCANDIUM IN NITRIC ACID–METHANOL MIXTURES. John P. Faris and Joseph W. Warton (Argonne National Lab., Ill.). Anal. Chem., 34: 1077-80(Aug. 1962). (TID-15598)

The adsorption of the rare earths, yttrium, and scandium from nitric acid–methanol solutions was studied using strongly basic anion exchange resins. Adsorption measurements were made at room temperature using the column elution technique and employing emission spectrographic analysis. Distribution coefficients were a function of both the volume percentage of alcohol and of the nitric acid concentration. The rare earths were eluted from a column in order of decreasing atomic number with little individual separation of those heavier than dysprosium. Those lighter than terbium had relatively large separation factors. Yttrium behaved like lutetium, while scandium was not adsorbed to an appreciable extent. Application of the system for macro separations was demonstrated in the preparation of extremely pure rare earths and for fractionation of crude rare earth mixtures. The simplicity of operation is attractive for analytical separation of trace impurities. (auth)

25281 DETERMINATION OF IRON AND URANIUM IN HIGH PURITY LEAD FOIL BY NEUTRON ACTIVATION ANALYSIS. P. A. Benson, W. D. Holland, and R. H. Smith (Tracerlab Inc., Richmond, Calif.). Anal. Chem., 34: 1113-16(Aug. 1962).

The sensitivity of neutron activation analysis for Fe and U was extended by employing more sensitive detection methods, more rigorous decontamination chemistry, and higher neutron fluxes. Uranium was determined by measuring the Np^{239} activity arising from the decay of U^{239}. Iron was determined by measuring simultaneously the Fe^{55} and Fe^{59} activation products. The lead foils contained 0.56 to 3.0 ppm iron and 0.91 to 0.020 ppb uranium. Minimum sensitivity was calculated to be 0.02 ppm iron and 0.006 ppb uranium in 100 mg of the foil. No error arose from the interfering reaction of $Co^{59}(n,p)Fe^{59}$. (auth)

25282 THALLIUM-204 RADIOMETRIC DETERMINATION OF DISSOLVED OXYGEN IN WATER. Harold G. Richter and Arthur S. Gillespie, Jr. (Research Triangle Inst., Durham, N. C.). Anal. Chem., 34: 1116-19(Aug. 1962).

A technique for determining the dissolved oxygen concentration of both pure and natural waters is based on quantitative oxidation of thallium metal containing Tl^{204} by aqueous dissolved oxygen. The analyzer consists of a column of thallium-204, deposited on copper turnings, below which is a flow-type Geiger-Mueller tube. Water containing the dissolved oxygen is passed through the column, whereupon Tl^{+} ions are formed. The Tl^{204} is detected in the G-M tube, and the counting rate is a direct measure of the dissolved oxygen concentration. In pure water the Tl^{204} counting rate is linear with dissolved oxygen concentration down to the lowest concentration investigated, 0.2 ppm. In sea water it is not linear above about 3 ppm and a calibration curve must be used. Linearity in sea water could be achieved by depositing the thallium on a metal more inert than copper. The effects of pH, buffers, and various oxidizing agents were studied. Using Tl^{204} of the highest specific activity available, it should be possible to determine 1 part of dissolved oxygen in 10^{12} parts of water. (auth)

25283 DETERMINATION OF MICRO AMOUNTS OF CARBON IN URANIUM TETRAFLUORIDE. R. E. Simmons and M. H. Randolph (Union Carbide Nuclear Co., Paducah, Ky.). Anal. Chem., 34: 1119-22(Aug. 1962). (TID-12773)

The method depends upon the conversion of carbon to carbon dioxide by igniting the sample, which is fluxed with silicon dioxide, in a high temperature combustion furnace with a flow of oxygen passing over the sample. The gases generated by igniting the sample are collected in an evacuated bulb and analyzed for carbon dioxide on an infrared spectrophotometer with no interference from the other gases present. The precision of the method for a single determination at the 95% confidence level is ±13% for 100 ppm carbon and ±30% for 50 ppm carbon. (auth)

25284 SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM IN THORIUM–ZIRCONIUM ALLOYS. A. R. Eberle, L. Pinto, and M. W. Lerner (New Brunswick Lab., New Brunswick, N. J.). Anal. Chem., 34: 1176-7(Aug. 1962).

In hydrochloric acid solution, zirconium is precipitated by p(p-dimethylaminophenylazo)benzenearsonic acid (pararsonic acid), DPB. When the precipitate is treated with either a basic or an acid fluoride solution, the free DPB is released. Although thorium is also precipitated to a small extent under conditions leading to the formation of the zirconium complex, the coprecipitation is constant and reproducible for a wide range of thorium concentrations when specific precipitation conditions are used. Fluoride interference is prevented by fuming with perchloric acid in the sample preparation. Digestion periods shorter than 45 minutes increase the thorium contamination; periods from 45 to 120 minutes result in nearly constant absorbance. With increasing concentrations above 1.80 N, zirconium recovery decreases. Between 1.75 and 1.85 N, the resulting absorbance is essentially constant. For the optical measurements, the less sensitive wavelength of 560 mμ is used because the absorbance at the absorption maximum near 500 mμ is generally too high to be measured. (N.W.R.)

25285 MICROCHEMICAL METHODS IN RADIOCHEMICAL ANALYSIS. II. DETERMINATION OF CHEMICAL YIELDS BY MICROCOULOMETRY. R. G. Monk and K. C. Steed (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Anal. Chim. Acta, 26: 305-15(1962). (In English)

Methods are described for the micro-coulometric determination of several elements using the Reilley and Porterfield method of generating EDTA by electrolysis of its mercuric chelate. The determination is carried out in a volume of about 1 ml of electrolyte, and polarized mercury electrodes are used to detect the end-point. 0.025 to 0.5 μeq of many elements can be determined using an ammoniacal electrolyte at pH 10.5 or an acetate buffer at pH 5.5. The method is designed for determining chemical yields of radiochemical procedures using 100 to 1000 μg amounts of carriers. (auth)

25286 THE SPECTROGRAPHIC DETERMINATION OF TOTAL BARIUM IN BONE ASH. M. S. W. Webb and M. L. Wordingham (Atomic Energy Research Establishment, Woolwich Outstation, Eng. and Royal Arsenal, London). Anal. Chim. Acta, 26: 349-54(1962). (In English)

Samples of bone ash are mixed with graphite and anhydrous copper sulphate as spectrographic buffer and lanthanum oxide as internal standard. The mixture is pressed into 30-mg pellets and burnt in a d-c arc surrounded by a mantle of oxygen and argon. The spectra are evaluated by non-recording microphotometry. The effective concentration range is 2 to 25 ppm of barium in the ash, and the coefficient of variation is 8% for single exposures at the 8-ppm level. (auth)

25287 THE DETERMINATION OF Sc, Y, Nd, Ce AND La IN SILICATE ROCKS BY A COMBINED CATION EX-

CHANGE-SPECTROCHEMICAL METHOD. R. A. Edge and L. H. Ahrens (Univ. of Cape Town). Anal. Chim. Acta, 26: 355-62(1962). (In English)

The combined use of cation exchange enrichment and spectrochemical analysis for the determination of rare earths in common silicate rocks is described. Rare earth elements are more strongly adsorbed by cation exchange resins than the abundant elements, hence the latter can be eluted with a concentration of acid which does not desorb the rare earths. The rare earths are then eluted by stronger hydrochloric acid and the effluent is evaporated to an amount of material sufficiently small to arc spectrographically. This procedure allowed the determination of Sc, Y, Nd, Ce and La in 13 South African granite rocks and Y, Nd, Ce and La in 6 South African basic rocks. (auth)

25288 ANALYSES OF ALUMINUM BY NEUTRON RADIOACTIVATION. Benito Chinaglia and Renzo Malvano. Automazione e strumentazione, 9: 92-6(1961). (In Italian)

The application of a neutron activation method to the determination of impurities in pure and superpure Al and for the fast and non-destructive analysis of Al alloys at low concentration is described. The elements determined were Mn, Ga, Cu, and Co. (J.S.R.)

25289 NEUTRON ACTIVATION OF PHOSPHORUS COMPOUNDS ON PAPER CHROMATOGRAMS. J. R. Robinson (Canada Dept. of Agriculture, London, Ont.). Can. Nuclear Technol., 1: 25-7(1962).

In biochemical studies of insecticide metabolites containing phosphorus, neutron irradiation allows the introduction of radioactivity in the final stage of the experiment, minimizing handling precautions, radiation effects, decay problems, and cutting cost. Principles of neutron activation as applied to phosphorus are reviewed, along with the limitations of the method. Interference from other elements, sample degradation, variations in neutron flux, availability of a neutron source, and cost are discussed. (M.C.G.)

25290 POLAROGRAPHIC ESTIMATION OF NIOBIUM WITH TANTALUM. Pavol Bunčák. Chem. průmysl, 11: 634-7(1961). (In Czech)

Polarographic estimation of niobium with tantalum in a medium of 75.5% sulfuric acid was elaborated. Two waves result from niobium reduction. Tantalum is polarographically inactive in the potential range used. This method can be applied for niobium estimation in niobium steels after the separation of oxides. Other applications are niobium estimation in high-speed steels, welds, and niobium minerals after separation of the blend of Nb_2O_5 and Ta_2O_5. (auth)

25291 APPLICATION OF MICRODIFFUSION METHODS FOR THE DETERMINATION OF CARBON DIOXIDE IN SOLID CARBONATES. H. Fueredi (Ruder Bošković Institute, Zagreb). Croat. Chem. Acta, 33: 201-7(1961). (In English)

A new absorption device is recommended as a modification of the Cavett apparatus. Its application for the determination of carbon dioxide in solid carbonates is discussed. Barium carbonate was used as a test substance. Determinations of carbon dioxide were carried out by decomposing the samples with hydrochloric acid, absorbing the evolved gas in barium hydroxide solution, and re-titrating the excess alkali with standard hydrochloric acid solution to a thymolblue end-point. Carbon dioxide was determined in the range of 0.3 to 3 mg with relative standard errors of 18 to 2%, respectively. Estimations were made with quantities of carbon dioxide as low as 70 μg. The results of carbon dioxide determinations in a precipitate of the system uranyl nitrate-barium chloride-sodium carbonate-water are shown. (auth)

25292 ACTIVATION AND ANALYTICAL PURITY TESTING OF RARE EARTHS. H. Grosse-Ruyken and H. Rommel (Technische Hochschule, Dresden). Isotopentechnik, 3: 66-9(Mar. 1962). (In German)

The degree of purity of Y_2O_3 and Sm_2O_3 from the VEB Stickstoffwerke Piesteritz was determined by activation analysis. The necessary separation of the rare earth impurities was made in a micro ion exchange column. The detection sensitivity of the apparatus with an analytic sample of 100 μ g was 10^{-5}% Sm, 5×10^{-4}% Eu, and 10^{-3}% Gd and Y. The apparatus used is described. (tr-auth)

25293 NEUTRON-ACTIVATION STUDY OF GALLIUM ARSENIDE CONTAMINATION BY QUARTZ. Werner Kern (Radio Corp. of America, Somerville, N. J.). J. Electrochem. Soc., 109: 700-5(Aug. 1962).

Gallium arsenide crystals were synthesized by the horizontal Bridgman method in neutron-activated boats of natural and synthetic fused quartz. Instrumental radiochemical techniques were applied to determine the silicon concentrations from Si^{31} radioactivity measurements and to identify other trace elements transferred to the gallium arsenide during the process. All crystals were found completely enveloped in an impurity-enriched surface layer containing silicon concentrations up to 1500 ppm. Bulk concentrations of silicon ranged from 1×10^{17} to 3×10^{18} atoms/cm^3 GaAs, and varied in different sections of the crystals within a factor of 1.7. Evidence of several types of transfer mechanisms was obtained. Other impurities that originated from natural fused quartz and were detected in the form of their radioactive isotopes in the crystals include copper, gallium, antimony, and gold at concentrations below 10^{16} atoms/cm^3; the concentrations of these contaminants were effectively decreased by use of high-purity synthetic quartz. (auth)

25294 THE ANALYSIS OF NIOBIUM AND NIOBIUM ALLOYS. W. T. Elwell and D. F. Wood. Metallurgia, 65: 308-10(June 1962).

Methods are briefly outlined for the determination of carbon, oxygen, nitrogen, chromium, iron, molybdenum, nickel, silicon, titanium, tungsten, and zirconium in niobium and its alloys. In many respects, analytical procedures suitable for these determinations are almost identical with those applied to comparable titanium and zirconium products, although niobium-bearing samples are more difficult to dissolve and alternative solvents are often used. Over the past few years the recommended procedures were used successfully for the analysis of a variety of samples. (auth)

25295 AN IMPROVED TECHNIQUE FOR THE DETERMINATION OF SHORT-LIVED FISSION-PRODUCT GASES. Charles W. Townley, Neil E. Miller, Thomas S. Elleman, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Nuclear Sci. and Eng., 13: 297-8(July 1962).

Radioactive gases are passed longitudinally through a long chamber containing an electrically charged stainless steel rod. When one of the gas nuclei decays in the chamber, the daughter nucleus is drawn to the rod. After a given period of exposure to the gas, the rod is sectioned and examined by gamma spectrometry. The short-lived nuclides Kr^{89}, Kr^{91}, Kr^{92}, Xe^{137}, Xe^{138}, Xe^{139}, Xe^{140}, and Xe^{141} are determined in the gas by this method, by means of determinations of the activities on the rod of their daughters Rb^{89}, Sr^{91}, Sr^{92}, Cs^{137}, Cs^{138}, Ba^{139}, Ba^{140}-La^{140}, and La^{141} respectively. The distributions of the decay activities along the rod agree with theoretical predictions. (T.F.H.)

25296 MEASUREMENT OF MOISTURE IN BROWN COAL BY ELASTIC BACK-SCATTERING OF FAST NEU-

TRONS. Ruediger Tornau and Karl Heinz Waechter. VDI Zeitschrift, 104: 901-2(July 1962). (In German)

The quality of briquettes is influenced to a considerable degree by the moisture content of the brown coal used in their manufacture. It was found that the moisture content of brown coal can be measured with the help of the elastic scattering of neutrons. (auth)

25297 ATOMIC-ABSORPTION SPECTROPHOTOMETRY. W. T. Elwell and J. A. F. Gidley. New York, The Macmillan Company, 1962. 108p. $5.00.

The use of atomic-absorption spectrophotometry for determing trace constituents in various elements is discussed. The developments being accomplished with this technique are described. (N.W.R.)

25298 ADVANCES IN X-RAY ANALYSIS. VOLUME 5. PROCEEDINGS OF THE TENTH ANNUAL CONFERENCE ON APPLICATION OF X-RAY ANALYSIS HELD AUGUST 7-9, 1961, DENVER, COLORADO. William M. Mueller, ed. New York, Plenum Press, 1962. 570p.

Forty-eight of the 56 papers presented at the Tenth Annual Conference on Applications of X-Ray Analysis are given. One paper presented at the Ninth Conference is also included. (M.C.G.)

General Inorganic and Physical Chemistry

25299 (AAEC/E-86) PURIFICATION OF CARBON DIOXIDE FOR REACTOR PURPOSES. PART III. DRYING. A. Draycott and A. C. Kerr (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Apr. 1962. 16p.

Comparison of the adsorption characteristics of the desiccants silica gel, alumina, and molecular sieves showed that molecular sieves have the greatest capacity at low partial pressures. Equilibrium data in the form of isotherms were established over the range of variables expected in the coolant circuit of a proposed Australian HTGC reactor. The mass transfer from the gas phase to molecular sieves is such that no correlation could be attempted for the adsorption zone height; the height proved to be too small. (auth)

25300 (ARL-62-358) HIGH TEMPERATURE THERMODYNAMIC PROPERTIES OF SELECTED GASES. Morton Rudin and Boris Ragent (Vidya, Inc., Palo Alto, Calif.). May 1962. Contract AF 33(616)-8338. 51p.

A review is given on high-temperature thermodynamic properties for air, N_2, O_2, Ar, and He, computed theoretically from statistical thermodynamics. The relationships and interrelationships of thermodynamic quantities and partition functions are discussed. After estimating the accuracy possible with the present state of the art, the sources of discrepancy among various papers are examined and accuracies relative to those possible under the state of the art are discussed. The individual character of each paper is reviewed in a chart containing information as to what data are available in the paper, the computing procedure used, and the expected accuracy. Recommendations regarding which tabulations are best or most useful for differing purposes in various temperature and pressure ranges are summarized. (auth)

25301 (BLG/B-1) BIBLIOGRAPHIE: TELLURE-132 (1939–1961). (Bibliography: Tellurium-132 (1939–1961)) R. Stiennon-Bovy (Brussels. Centre d'Étude de l'Énergie Nucléaire). Jan. 1962. 16p.

Ninety-three references on the nuclear characteristics, chemical properties and analyses, production, use as generator of I^{132}, dosimetry, presence in radioactive fall-out, and applications of Te^{132} are given to U. S. and foreign journals, patents, and reports published from 1939 to 1961. A separate author index is included. (P.C.H.)

25302 (BMI-1585) REACTIONS BETWEEN URANIUM OXIDE AND BIVALENT METAL OXIDES AT 60,000 ATM. Arthur P. Young and Charles M. Schwartz (Battelle Memorial Inst., Columbus, Ohio). July 10, 1962. Contract W-7405-eng-92. 12p.

Mixtures of uranium oxide and bivalent metal oxides were reacted at 60,000-atm pressure and at temperatures from 900 to 1200°C. A CaU_2O_5 compound with Cu_3Au-type ordering of uranium and calcium ions was synthesized at high pressure. This is the first instance of Cu_3Au-type ordering in a mixed oxide. High-pressure CaU_3O_{3+x} samples with x varying from −0.25 to 0.60 had the UO_2 structure with reduced lattice parameter, but were not ordered. There were no observable superlattice reflections in the x-ray diffraction pattern of the samples. The dependence of ordering on oxygen content can be qualitatively explained if oxygen is assumed to go into body-centered sites in CaU_3O_{3+x} fluorite-type compounds. Solid solutions of MgO and ZnO in the UO_2 fluorite structure with lattice parameters as low as a_0 = 5.24 Å were found in high-pressure samples. Also, magnesium uranate, $MgUO_4$, and zinc uranate, $ZnUO_4$, were synthesized at high pressure. Some solubility of MgO in UO_2 was noted at ambient pressure in agreement with the observations of other investigators. However, solubility of ZnO in UO_2 and formation of zinc uranate occurred only at high pressure. There was no observable reaction between uranium oxide and nickel oxide at ambient pressure. Solid solutions of NiO in UO_2 were not formed at high pressure. However, nickel uranate, $NiUO_4$, was synthesized at high pressure. (auth)

25303 (BMI-1587) HELIUM SOLUBILITY IN D_2O AT ELEVATED TEMPERATURES AND PRESSURES. Elmer F. Stephan, Warren E. Berry, and Frederick W. Fink (Battelle Memorial Inst., Columbus, Ohio). July 23, 1962. Contract W-7405-eng-92. 14p.

The solubility of helium in heavy water was determined at 50, 100, 150, 200, 240, and 280°C and at helium partial pressures in the range of 50 to 1150 psia. Within the range of temperatures and pressures investigated, the solubility increased with temperature and appeared to be a linear function of the partial pressure of helium. Solubility in heavy and light water appeared to be similar on a volume basis. (auth)

25304 (BNL-6050) ISOTOPE EFFECTS ON INTERMOLECULAR INTERACTIONS AND ISOTOPIC VAPOR PRESSURE DIFFERENCES. Max Wolfsberg (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(3022)-Gen-16]. 4p.

Problems in the calculation of isotope effects on the vibrational frequencies of the condensed phase in gas-solid systems were studied. The isotope effect on intramolecular frequencies due to dispersion or van der Waals forces between symmetric nonpolar molecules was determined. Isotope effects on vapor pressure were calculated. (M.C.G.)

25305 (CEA-1650) ETUDE DE LA FIXATION D'IONS PHOSPHORIQUES PAR LA MONTMORILLONITE–ZIRCONIUM. (A Study of the Fixing of Phosphoric Ions by Zirconium–Montmorillonite). R. Bittel, C. Boursat, and R. Platzer (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1960. 8p.

In connection with the research carried out on the purifi-

cation of nuclear reactor water, a study is made of the ion-exchange properties of acid montmorillonite. Zirconium-montmorillonite fixes very strongly the phosphorus from solutions of phosphoric acid or of phosphates on 1 g of clay it is possible to fix 1.2 milli-atoms-gram of zirconium and the zirconium montmorillonite itself fixes 2.1 milli-atoms-gram of phosphorus. An explanation is that the fixing of phosphoric ions modifies the distribution of the ions between the platelets and precipitates a very slightly soluble product of the type diphospho-zirconic acid. (auth)

25306 (CEA-2125) PROPRIETES CHIMIQUES DE QUELQUES ELEMENTS DANS L'EUTECTIQUE CHLORURE DE LITHIUM, CHLORURE DE POTASSIUM FONDU (theses). (Chemical Properties of Some Elements in a Molten Lithium Chloride, Potassium Chloride Eutectic (thesis)). Roger Molina (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 78p. Submitted to Univ. of Paris.

Structural studies on molten solutions show the existence of certain species such as ions and complexes known to exist in aqueous solutions. This fact, together with certain experiments on chemical reactions in molten media instigated a comparison between these media and aqueous solutions. It is shown that the same fundamental phenomena occur in these media as are found in the chemistry of aqueous solutions and that this makes it possible to predict certain reactions. The chemical properties of vanadium, uranium, and sulfur in a LiCl–KCl eutectic melted at 480°C were used as examples. The absorption spectra obtained in aqueous solution and in the molten eutectic were compared. (auth)

25307 (CEA-Bib-15) CONSTANTES PHYSIQUES DES VARIÉTÉS ISOTOPIQUES DE L'EAU ($H^{17}O-H^{18}O-D-T$). (Physical Constants of Isotopic Substitutions in Water ($O^{17}-O^{18}-D-T$)). J. Dirian (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 108p.

The physical and thermodynamic properties of isotopic substitutions in water molecules were compiled from 1950 to 1961, excluding atomic and nuclear properties. Infra-red spectra were included, however, owing to their increasing importance in connection with the properties of isotopic species. The most important data from each work are presented, according to their form in original tables or graphs. There are 119 references. (auth)

25308 (DMIC-170) CHEMICAL VAPOR DEPOSITION. J. M. Blocher, et al. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). June 4, 1962. Contract AF 33(616)-7747. 82p.

Six independent papers dealing with chemical vapor deposition are presented. The potential and the problems are presented. Some of the fundamental characteristics of the process are discussed. Specific consideration is given to the use of the method in the production of protective coatings and whiskers. (auth)

25309 (DP-727) A METHOD FOR DETERMINING THE DIFFUSION COEFFICIENT OF AN ALPHA EMITTER IN A SOLID. LeVerne P. Fernandez (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1962. Contract AT(07-2)-1. 12p.

A method was developed for determining the rate of diffusion of alpha-emitting nuclides in ion exchange resins. The method was used to study the rate of diffusion of the anions of Np(IV) and Pu(IV), which were absorbed from solutions of 8M HNO_3, in Dowex 1-X4 and Permutit SK anion exchange resins. (auth)

25310 (DP-737) DISSOLVING PLUTONIUM METAL IN SULFAMIC ACID. William J. Jenkins (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1962. Contract AT(07-2)-1. 6p.

Plutonium metal was found to dissolve readily in sulfamic acid and in mixtures of sulfamic and nitric acid. The method of dissolution is convenient in a plant process for the recovery of off-standard metal. (auth)

25311 (IG-Memo-466) PRELIMINARY WORK ON MOLYBDENUM SPECIES IN NITRIC ACID. J. D. Cocker and V. M. Sinclair (United Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland). June 1959. 32p.

Investigations were made to determine the nature of Mo species in HNO_3 media. Spectral measurements show that Mo(V) has a maximum near 430 mμ in HNO_3. Attempts to determine Mo(V), in the presence of Mo(VI), in HNO_3 were unsuccessful. The extraction of Mo(VI) from a solution of ammonium molybdate in HNO_3 by tributyl phosphate was found to have a maximum depending on the acidity of the added nitric acid. The optimum acidity for maximum extraction depends on the Mo concentration. The spectrum of the TBP solution of Mo(VI) exhibited an absorption band near 750 mμ, indicating compound formation. Mo(VI) in HNO_3 does not form anionic complexes as it does in HCl. Equilibrium experiments using cation and anion exchange resins indicate that Mo(VI) in HNO_3 can exist as species with one charge per Mo atom. Uranyl molybdate was found to be a product of treating U–Mo alloys with HNO_3. Molybdenum(VI) and (V) are also formed, the latter material possibly being colloidal. (P.C.H.)

25312 (JEN-90-DQ/I-24) PROGRAM OF CHEMICAL RESEARCH ON ORGANIC MODERATORS AND COOLANTS IN REGARD WITH THE PROJECT OF THE SPANISH DON-REACTOR. R. Fernandez Cellini (Spain. Junta de Energia Nuclear, Madrid). 1961. 13p.

In order to select the most suitable mixtures for cooling the DON reactor within the group of polyphenyl compounds, which at present prevails in organic power reactor philosophy, the following subjects were studied: static and dynamic experiences of thermal and radiolytic stability of commercial polyphenyl mixtures, purification of the damaged coolant, applications of the residual polymers, and analytical control and measurement of the physical constants of the polyphenyl mixtures. (auth)

25313 (K-1433) MASS SPECTROMETER DETERMINATION OF MOLYBDENUM–URANIUM RATIOS IN MIXTURES OF THE HEXAFLUORIDES. J. C. Horton, J. R. Thomas, and V. L. Warren (Oak Ridge Gaseous Diffusion Plant, Tenn.). July 3, 1962. Contract W-7405-eng-26. 9p.

A mass spectrometer was developed for comparing the ratios of molybdenum to uranium in mixtures of their hexafluorides containing approximately one % molybdenum. Because of the large mass difference, the analyzer is enlarged to house separate collectors which receive the uranium and molybdenum ions simultaneously. Automatic instrumentation directs samples into the ion source, regulates the uranium ion intensity, and records the ratios. Pairs of mixtures are compared to obtain a ratio of molybdenum hexafluoride/uranium hexafluoride mole ratios. This ratio of ratios, R, can be determined to ±0.3% of the value of R, at the 95% confidence level, in 15 minutes. (auth)

25314 (KY-399) DESIGN OF A PILOT SCALE FLUORINE CELL RESEARCH FACILITY. W. K. Henderson, W. B. Goode, S. Bernstein, and E. J. Tullos (Union Car-

bide Nuclear Co. Paducah Plant, Ky.). July 19, 1962. Contract W-7405-eng-26. 17p.

To improve cell life and reduce the unit cost of fluorine, a pilot plant was designed and constructed. The test facility was designed so that data obtained from experimental cells would be comparable to that expected from plant scale equipment. Ease of assembly, handling, inspection, and repair were also major factors in establishing the design criteria. The unit has operated safely, with very little attention, for extended periods of time. Photographs and diagrams of the facility are presented, and instrumentation, electrical, and temperature control systems are described. (auth)

25315 (NP-11758) THE OXIDATION AND STOICHIOMETRY OF PRASEODYMIUM AND CERIUM OXIDES. A. F. Clifford (Purdue Research Foundation, Lafayette, Ind.). Aug. 31, 1961. Contract AF18(603)-45. 64p.

Results of an investigation of Pr is presented. Separate report sections are included on PrO_x–O_2 isotherms, proposed model of a PrO_x domain, the stoichiometry and resistivity of PrO_x, infrared spectra of PrO_x and $Pr_2(CO_3)_3$, x-ray study of PrO_x, and a Pr_6O_{11} oxygen generator. (J.R.D.)

25316 (NP-11921) STUDY OF THE EXCESS CONDUCTIVITY IN PLASTICALLY DEFORMED ALKALI HALIDES. P. Camagni, G. Chiarotti, and A. Manara (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra and Pavia, Italy. Universitâ. Istituto di Genetica). May 1962. 19p.

The results of measurements on the excess ionic conductivity of plastically deformed alkali halides are given. The recovery of conductivity after deformation was investigated at various temperatures in KCl, KBr, NaCl, and LiF, with the aim to reach some knowledge on the nature of the defects responsible for enhanced conduction. It was found that the excess defects undergo bimolecular annealing, their mobility being controlled by a defined migration energy which is characteristic of a given salt. The results are qualitatively discussed with reference to some specific models. A simple treatment was developed in order to justify formally the observed behavior. (auth)

25317 (NYO-9837) POLAR-NONPOLAR OR AMPHIPATHIC INORGANIC COMPOUNDS. Progress Report. U. P. Strauss (Rutgers Univ., New Brunswick, N. J.). [1962]. Contract AT(30-1)-1018. 6p.

Results of molecular studies showed that, depending on the chemical composition, polyphosphates are either linear or branched flexible chain molecules. The branch points were easily destroyed by hydrolysis. Hydrolytic stability studies showed that the rate constants are much smaller for the splitting of internal bonds than for the hydrolysis near the chain ends, where both monomeric and trimeric rings are formed. The kinetic study of the degradation of sodium pentaphosphate was continued. Preliminary results indicated that, in the absence of calcium, the formation of each trimeric ring is accompanied by the formation of two orthophosphate rather than one pyrophosphate molecule. The influence of different univalent cations on the behavior of polyphosphates was studied by electrophoresis, conductivity, membrane equilibrium, and viscosity measurements. The effects of divalent ions were also studied. (M.C.G.)

25318 (RAD-TM-60-44) THE REACTION OF GLASSES, PYROLYTIC GRAPHITE, AND SELECTED REFRACTORIES WITH SODIUM VAPOR AT ELEVATED TEMPERATURES. Michael E. Ihnat (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). Apr. 1960. Reprinted June 1962. Contract AF49(638)-659. 30p. (AFOSR-TN-60-871)

Vycor, Pyrex, boron nitride, aluminum oxide (Morganite), beryllium oxide, magnesium oxide (99% dense), aluminum oxide (fully dense), and pyrolytic graphite were exposed to sodium vapor at a measured temperature of 940°C (1725°F) for a period of fifteen minutes. The complete loss of the Vycor sample, structural disintegration of pyrolytic graphite, reaction of Pyrex, and diffusion of sodium into the less dense ceramics was observed. A corrosive reaction of type 304 stainless was observed where it was in contact with the Vycor sample. The test shows the need for dense ceramics where sodium vapors are to be in contact with alkali metal propulsion system components. (auth)

25319 (TID-16128) THE COPRECIPITATION OF METALLIC IONS WITH CALCIUM CARBONATE. Annual Report. H. D. Holland, M. W. Bodine, Jr., M. Borcsik, J. S. Huebner, T. V. Kirsipu, J. Munoz, and P. E. Rosenberg (Princeton Univ., N. J.). June 15, 1962. Contract AT(30-1)-2266. 55p.

Investigations are reported on the coprecipitation of Sr and Mn with $CaCO_3$, examination of the stability of calcite, dolomite, magnesite, and siderite; and application of these data to several geologic problems. Rhombohedral carbonates in the solid solution series calcite ($CaCO_3$)-rhodochrosite ($MnCO_3$) were precipitated at several temperatures under CO_2 pressure. Experimental studies suggest that 2 solvuses exist in the system—one between calcite and kutnahorite, and a second between kutnahorite and rhodochrosite. Work on coprecipitation of Sr^{+2} with calcite and aragonite is also reported along with coprecipitation of Cd^{+2} with ZnS, precipitation of carbonates in the system $CaCO_3$-$MgCO_3$-H_2O, thermal dissociation of siderite, and coprecipitation of Sr^{+2} with calcite and aragonite in caves. Results of a study on the origin of the ore deposits at Providencia, Mexico, are also included. (J.R.D.)

25320 (TID-16157) THE DETERMINATION OF APPEARANCE POTENTIALS BY THE CRITICAL SLOPE METHOD. Technical Report No. IX. Ariel F. Barfield and Austin L. Wahrhaftig (Utah. Univ., Salt Lake City). June 20, 1962. Contract AT(11-1)-1101. 15p.

Various models for the calculation of mass spectra, the critical slope expressions, if any, predicted by these models, and, where indicated, some relationships between the models are discussed. In addition to the question of the electron energy spread, assumptions as to the number of energy states available to the molecule-ion were also considered. Situations discussed include: a single state and monoenergetic electrons, a continuum of states and monoenergetic electrons, a single state and an electron energy spread, a continuum of states and an electron energy spread, and fragmentation. Expressions were derived for the total ionization as a function of electron energy for four different models. (M.C.G.)

25321 (TID-16224) THE SYNTHESIS OF ORGANOLANTHANIDE DERIVATIVES. Fifth Quarterly Progress Report, Period Ending May 15, 1962. (Ethyl Corp. Research and Development Div., Detroit). Contract AT(11-1)-999. 16p.

The chloride ion in dicyclopentadienyllanthanide chlorides was found to be easily displaced by anions such as acetate, formate, benzoate, methoxide, phenoxide, and amide to yield the corresponding substituted dicyclopentadienyllanthanide derivatives. Cyclopentadienyllanthanide dichlorides of Sm, Eu, Gd, Ho, and Er were prepared by treating the corresponding trichlorides with one equivalent of cyclopentadienylsodium. A similar type of ytterbium complex, cyclopentadienylytterbium dichloride, was prepared from dicyclopentadienylytterbium chloride and one equivalent of

hydrogen chloride. The complexes, all isolated as the tris-tetrahydrofuranates, represent a new class of organolanthanides. (auth)

25322 (TID-16292) TRANSIENT ELECTRODE POTENTIALS OF NICKEL. Technical Report No. 42. A. M. Spencer, M. E. Wadsworth, and M. A. Cook (Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes). May 18, 1962. Contract AT(11-1)-1144. 39p.

Nickel wire was stretched at a constant rate which uncovered new surface area at a constant rate. The strain and decay potentials were recorded for a variety of systems consisting of water and salt solutions, several alcohols, fused salts, and temperature changes in water. Both the strain and decay potentials vary linearly with logarithm of time under all conditions studied. The maximum potentials in the alcohols were about 400 mv; in water about 300 mv. The maximum potentials in water were strain rate dependent. The strain potential is most probably due to the change in concentration of active bare surface sites which are in turn related to the new area. The increase in new area is a direct function of time and an equation similar to the Nernst equation can be written $E = k_1 \log k_2 A$, where E is potential, A is area and k_1 and k_2 are constants. The decay potentials arise from back reactions which corrode the surface and reform the disrupted film. The slope of the potential vs logarithm of time curve is indicative of the rates of these reactions. All effects can be qualitatively explained as being due to the rupture of the surface film and resulting reactions with active surface sites and repair of the oxide layer. (auth)

25323 (TID-16350) THE SOLID STATE CHEMISTRY OF RARE EARTH OXIDES. Technical Progress Report. Leroy Eyring, Bo. Holmberg, Bruce Hyde, Panos Kokoropolous, and Theron Felmlee (Arizona State Univ., Tempe). July 12, 1962. Contract AT(11-1)-1109. 84p.

Rate studies of the oxidation of Pr_6O_{11} to PrO_2 by oxygen gas at one atmosphere, in the temperature range 234 to 314°C, and the vacuum reduction of PrO_2 to Pr_6O_{11} in the temperature range 242 to 347°C are reported. The kinetics of both processes are analyzed and with minor modifications would appear to fit the equation for a phase-boundary-controlled mechanism quite accurately over most of the composition range involved. Stable phases in the rare earth oxide systems are also reported and discussed. The structural interrelations between A, B, and C type sesquioxides and fluorite dioxides are pointed out, and the structural relation between the sequence of intermediate phases, in the CeO_x, PrO_x, and TbO_x systems, and the sesquioxides and dioxides are considered. A parallel hypothetical homologous series of general formula M_nO_{2n-1} is suggested. (P.C.H.)

25324 (TID-16392) A STUDY OF OXYGEN SOLUBILITY IN WATER AND THORIA SLURRIES AT ELEVATED PRESSURES AND TEMPERATURES. Technical Report Number XIV. Monte B. Shirts and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). Nov. 8, 1961. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26; Subcontract 1075. 33p.

Oxygen sorption in a demineralized water system, thoria slurry, platinum catalyst slurry, and thoria–platinum catalyst system was studied. Curves for each system are given, and the results discussed. Oxygen was injected into each system using a common procedure. The autoclave was heated to 280°C, pressure in the charging system built up to 1000 psi, and the oxygen charged while the autoclave was being agitated. Results showed that the apparatus and the procedure followed were capable of reproducing itself, and reproducing published literature. Oxygen adsorbed on 16.3% of the surface of the thoria in the thoria slurry charge and three moles of oxygen were adsorbed per mole of platinum metal in the platinum catalyst slurry charge. Data from the thoria-plantinum catalyst slurry indicated a reaction between the platinum catalyst and the free thoria, or at least on interference in the adsorption of oxygen on the individual components. This reaction or interference was dependent upon the partial pressure of oxygen in the gas phase of the autoclave, the temperature of the slurry, and the amounts of thoria and platinum present. It was independent of hydrogen reduction, and the thoria to platinum ratio. (auth)

25325 (USNRDL-TR-566) VAPOR PRESSURES IN THE LIQUID SYSTEM $Rb_2O-B_2O_3$. DERIVED THERMODYNAMIC DATA AND A STRUCTURAL INTERPRETATION. C. E. Adams and J. T. Quan (Naval Radiological Defense Lab., San Francisco). June 6, 1962. 68p.

By use of the transpiration method, the vapor pressures of the liquid system $Rb_2O-B_2O_3$ between pure B_2O_3 and $Rb_2O-B_2O_3$ were measured. The vapor over the entire composition range was an equimolar mixture of Rb_2O and B_2O_3. Data from other sources indicate that the vapor molecule should be $RbBO_2$. The activity of the $RbBO_2$ in the melts showed a pronounced discontinuity at about 15 mole % Rb_2O. The activity and other thermodynamic data were compatible with a liquid structure based on Biscoe and Warren's theory, which describes the structures of alkali borate glasses. The activity of the $RbBO_2$ in the melts and the vapor pressure of the $RbBO_2$ above the melts could be decreased by the addition to the melt of oxygen-complexing cations. (auth)

25326 (AEC-tr-5117) ZIRCONIUM AND HAFNIUM OXYFLUORIDES. Yu. A. Buslaev, Yu. E. Gorbunova, and M. P. Gustyakova. Translated by Martha W. Gerrard (Oak Ridge National Lab., Tenn.) from Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 2, 195-201(1962). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 18869.

25327 (AEC-tr-5126) THE STRUCTURE OF WATER AND WATER SOLUTIONS. Antun Gertner and Iva Bačić. Translated from Farm. Glasnik, 16: 119-26(1960). 9p.

Studies of the structure of water are reviewed. The solubility of materials in water and the structure of solutions are also discussed. (M.C.G.)

25328 (AEC-tr-5205) CONCERNING A SODIUM URANIUM(V) FLUORIDE, Na_3UF_8. Walter Ruedorff and Hans Leutner. Translated by Robert A. Penneman and Gretchen R. Riese (Los Alamos Scientific Lab., N. Mex.) from Ann. Chem., Liebigs (Ann.), 632: 1-7(1960). 15p.

By fluorination of trisodium uranium(IV) fluoride at 390° the almost colorless trisodium uranium(V) fluoride was obtained 97% pure. The compound crystallizes tetragonally with a = 5.47, c = 10.94 Å. In the transformation $Na_3UF_7 \rightarrow Na_3UF_8$, the free anion positions in the uranium (IV) compound become occupied by fluorine. The magnetic moment with $\theta = -150°$ is calculated to be 2.29 BM. (auth)

25329 (AEC-tr-5249) GROWTH OF LARGE PERFECT CRYSTALS OF ALPHA URANIUM BY STRAINING AND ANNEALING OF POLYGONIZED SINGLE CRYSTALS OBTAINED BY CHANGE OF PHASE. Jean Mercier, Daniel Calais, and Paul Lacombe. Translated by J. W. Colby, P. R. Morris, and E. S. Noe' (National Lead Co. of Ohio, Cincinnati) from Compt. rend., 246: 110-13(Jan. 6, 1958). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 7633.

25330 EQUILIBRIUM RELATIONS FOR SYSTEMS OF SULFURIC ACID SOLUTIONS OF URANIUM AND ANIONIC RESIN. J. Estrada, B. López, A. Uriarte, and L. G. Jodra (Junta de Energia Nuclear, Madrid). Anales real soc. españ. fís. y quím. (Madrid), Ser. B, 58: 129-44(Feb. 1962). (In Spanish)

The application of ion exchange requires the knowledge of equilbrum relations which in turn permits the calculations of continuous ion exchange units. Equilibrium relations were determined for systems of uranyl sulfates and anionic XX resin. The influences of sulfate, phosphate, and ferric ions on equilibrium for a wide range of concentrations were studied, and equilbrium relations as Freundlich's isotherm for each case were calculated. The relations for synthetic solutions are applied successfully to acid leaching solutions from Spanish uranium ores. (auth)

25331 THE EMISSION SPECTRUM OF SILVER DEUTERIDE. Ulf Ringstroem (Univ. of Stockholm). Arkiv Fysik, 21: 145-60(1962). (In English)

The emission spectrum of silver deuteride (AgD) was studied in the region 3100–3900 Å. Analyses were performed on 15 bands of a band system which was assigned to a $^1\Sigma - {}^1\Sigma$ transition. The constants obtained for the ground state are (cm^{-1}): ω_e = 1250.70, α_e 0.0720, $\omega_e x_e$ = 17.18, $D_e = 8.54 \times 10^{-5}$, B_e = 3.256, $\beta_e = -0.4 \times 10^{-6}$, and ν_{00} = 29911.22. The upper state is strongly perturbed. The constants B and D for this state may therefore not be regarded as true constants. The extrapolated values for the rotationless state (not corrected for the influence of the perturbations) are: B_0' = 3.102, B_1' = 2.984, B_2' = 2.847, B_3' = 2.693, B_4' = 2.508, and $D_e' \simeq 9.7 \times 10^{-6}$. A treatment of the perturbation, which is of the homogeneous type, is given, and it is shown that the perturbing state has a B value of approximately 1.8 cm^{-1}. (auth)

25332 TRITIUM–HYDROGEN EXCHANGE IN STUDIES OF PROTEIN STRUCTURE. S. J. Leach and P. H. Springell (Commonwealth Scientific and Industrial Research Organization, Victoria, Australia). Australian J. Chem., 15: 350-64(May 1962).

Tritiated water (THO) was used in the study of exchangeable H atoms in proteins to provide information on molecular structure. On account of the high sensitivity of detection methods for tritium, it need be used only in tracer amounts. This leads to several advantages over deuterium: there is less risk of conformational changes occurring in the labelled protein, lower protein concentrations may be used (0.2 to 2.0%), and rates of exchange are slower. The method was used to study the T-H exchange of ribonuclease dissolved in THO and the H-T exchange of the N,O-tritiated protein dissolved in H_2O between 0 and 70°C. The extent of exchange was measured in the former case by T-assay on aliquots of dried protein and in the latter case by T-assay on water samples collected by sublimation. Optimal conditions for sampling, drying, and T-assay are described under which further exchange was minimized. In particular, it was found unnecessary to dry at temperatures above 40°C. The number of exchangeable H atoms in the ribonuclease molecule was determined as a function of temperature. As reported by Schildkraut and Scheraga (1960) there appears to be a critical temperature below which certain H atoms will not exchange within 24 hr. However, the number of such atoms (50 to 60) is greater, and the critical temperature (42°C) lower than previously reported. This discrepancy is discussed as well as the significance of slow and rapid H exchange in relation to protein conformation. (auth)

25333 PROTON CONDUCTIVITY IN LITHIUM SULFATE MONOHYDRATE AND THE MOTION OF ITS WATER MOLECULE. S. Marčić. V. Pravdić, and Z. Veksli (Ruder Bošković Institute, Zagreb). Croat. Chem. Acta, 33: 187-95(1961). (In English)

Proton conductivity is established in lithium sulfate monohydrate by electrolysis experiments in the solid state. This effect is discussed in relation to the large amplitude oscillations of the water molecule as evidenced by proton magnetic resonance measurements at different temperatures. The importance of the unidirectional chain-like structure of hydrogen bonds in this substance is emphasized, and several implications of the proton conductivity are mentioned. (auth)

25334 THE STANDARD HEATS OF FORMATION OF NIOBIUM PENTOXIDE AND OF TANTALUM PENTOXIDE. A. N. Kornilov, V. Ya. Leonidov, and S. M. Skuratov (Moscow Univ.). Doklady Akad. Nauk S.S.S.R., 144: 355-8 (May 11, 1962). (In Russian)

Values for the heats of formation reported in the literature vary from −442.8 to −472.6 kcal/mol for Nb_2O_5, and from −309.5 to −499.9 kcal/mol for Ta_2O_5. The reason for the discrepancy in the data is due to impurities in the Ta and Nb metals which are burned to the oxides. Samples of Nb and Ta metal were prepared and analyzed by two different laboratories. Corrections were applied for the small amount of impurities found in the sample. The standard heats of formation were found to be −453.5 ± 0.4 kcal/mol for the β-modification of Nb_2O_5, and −489.3 ± 0.4 kcal/mol for the α-modification of Ta_2O_5. Consistent results were obtained on the heat of burning of samples of Nb and Ta of different origin, in which the impurity content was low and accurately known. (TTT)

25335 THE EFFECT OF STRUCTURE AND OF MEDIUM ON THE REACTIVITY OF A HYDROCARBON DURING INTERACTION WITH FREE METHYL RADICALS IN A LIQUID. I. V. Berezin and O. Dobish (Moscow Univ.). Doklady Akad. Nauk S.S.S.R., 144: 374-7(May 11, 1962). (In Russian)

An overall reaction rate constant k_{Σ}^{h} can be written for the reaction $RH + {}^{\bullet}CH_3 \rightarrow CH_4 + R^{\bullet}$. Each type of C–H bond in the molecule may be assigned a partial rate constant k_i^h, and the overall rate constant is equal to the sum of the partial rate constants. New data on the reactivity of a number of hydrocarbons with methyl radicals were obtained by using tritium-tagged n-heptane (n-heptane-4t) as a standard. Free methyl radicals were produced by the thermal decomposition of acetyl peroxide at 60 to 90°C. The specific activities of the methane formed with n-heptane-4t alone, and of the methane formed with n-heptane-4t mixed with the hydrocarbon RH, gave the required data to determine the overall reaction rate constant as related to the reaction rate constant for n-heptane alone that is, the ratio $k_{\Sigma}^{H}/k_{hep}^{H}$. It was found from a comparison of the data for heptane and toluene that replacement of an aliphatic group by a phenyl group leads to a reactivity increase by a factor of 37. The introduction of a double bond into a cyclic compound increased the reactivity of an alpha C–H bond by a factor of 27 to 39, as can be seen from a comparison of the data on cyclohexane and cyclohexene, and on cyclopentane and methylcyclopentene. A conjugated double bond system confers increased reactivity on the adjacent C–H groups. (TTT)

25336 APPLICATION OF INFRARED SPECTROSCOPY TO THE STUDY OF UO_2^{2+} SORPTION BY CELLULOSE MATERIALS. S. S. Gusev and I. N. Ermolenko. Kolloid. Zhur., 24: 278-82(May-June 1962). (In Russian)

The most characteristic changes in infrared absorption spectra are observed in the region 1700 to 1500 cm^{-1} and 940 cm^{-1}. Measurements of band intensities in these regions for the products of uranyl sorption on carboxymethylcellulose and dicarboxycellulose at various intervals of the sorption process, including the equilibrium state, showed that sorption at every stage proceeds largely according to the mechanism of ion exchange with the carboxyl groups. The molar coefficient of absorption of the carboxylate CO of the cellulose salts investigated is practically the same for the various cellulose materials and equals about half the value of the absorption coefficient of the carboxyl CO band. (auth)

25337 THE SOLID RARE EARTH CHELATES OF ETHYLENEDIAMINETETRAACETIC ACID. R. S. Kolat and J. E. Powell (Iowa State Univ., Ames). Inorg. Chem., 1: 485-93(Aug. 1962). (IS-297)

The solid acidic chelates formed by the reaction of the tripositive rare earth ions with the protonated ethylenediamine-N,N,N′,N′-tetraacetate ligand were studied by means of thermobalance, infrared, and x-ray diffraction measurements. The oven-dried (110° for 24 hr) chelates of cerium through samarium were found to be monohydrated, while the remaining members were anhydrous. Infrared studies suggested that the change in hydration number was accompanied by a change in the amino acid ligand from a pentadentate to a hexadentate configuration. Measurements of the acid dissociation constants of these chelates indicated that a corresponding change does not take place in solution. (auth)

25338 PREPARATION AND PROPERTIES OF LITHIUM OZONIDE AND THE USE OF AMMONIA IN THE PREPARATION OF OZONIDES. Andrew J. Kacmarek, John M. McDonough, and Irvine J. Solomon (Illinois Inst. of Technology, Chicago). Inorg. Chem., 1: 659-61(Aug. 1962).

The tetraammoniate of lithium ozonide was prepared and characterized. The ammoniated compound decomposes when the ammonia is removed. Lithium ozonide is the most soluble of the alkali metal ozonides in liquid ammonia. The density of a solution containing 89% by weight of $LiO_3 \cdot (NH_3)_4$ in liquid ammonia at –74° is 0.997 g/cc. The compound shows a visible spectrum characteristic of the other alkali metal ozonides, with a maximum near 450 mμ. The heat of formation of the tetraammoniate was found to be –135 ± 5 kcal/mole. (auth)

25339 HEXAFLUORIDES OF MOLYBDENUM, TUNGSTEN, AND URANIUM. I. REACTIONS WITH NITROUS AND NITRIC OXIDES. J. R. Geichman, E. A. Smith, S. S. Trond, and P. R. Ogle (Goodyear Atomic Corp., Portsmouth, Ohio). Inorg. Chem., 1: 661-5(Aug. 1962). (GAT-T-969)

Reaction of nitric oxide with molybdenum and uranium hexafluorides gives the solid ionic compounds $NO^+[MoF_6]^-$ and $NO^+[UF_6]^-$. These same compounds result when molybdenum and uranium pentafluorides are allowed to react with nitrosyl fluoride. No reaction occurs between nitric oxide and tungsten hexafluoride, while nitrous oxide does not react with tungsten, molybdenum, or uranium hexafluorides. (auth)

25340 PHASE EQUILIBRIA IN THE SYSTEM CHROMIUM(II) FLUORIDE–CHROMIUM(III) FLUORIDE. Bernard J. Sturm (Oak Ridge National Lab., Tenn.). Inorg. Chem., 1: 665-72(Aug. 1962).

An investigation of the CrF_2–CrF_3 system established the existence of a single chromium(II,III) fluoride covering the solid solution range $CrF_{2.49}$ to $CrF_{2.45}$. There are two invariant points, the eutectic at 831 ± 5° containing 14 mole % CrF_3 and the peritectic at 997 ± 5° containing 29 mole % CrF_3. CrF_3 forms a solid solution containing 10 mole % CrF_2. Melting points of the components CrF_2 and CrF_3, both previously reported to be 1100°, were determined to be 894 ± 6° and 1404 ± 20°, respectively. Because classical procedures yielded mixed products, new methods of synthesizing CrF_2 were sought. Five new procedures are reported: disproportionation of CrF_3 at 1100°, pyrolysis of $(NH_4)_3CrF_6$, reduction of CrF_3 with Cr^0 at 1100°, reduction of $CrCl_3$ with molten SnF_2, and oxidation of Cr^0 with a molten fluoride of a more noble metal, SnF_2, PbF_2, CuF_2, CdF_2, or BiF_3. $(NH_4)_3CrF_6$ for the preparation of CrF_3 and CrF_2 was synthesized by the reaction of molten NH_4HF_2 with $CrF_3 \cdot 3H_2O$, CrO_3, or $(NH_4)_2Cr_2O_7$. The compound chromium(II,III) fluoride, previously unreported, was encountered when the disproportionation of CrF_3 was incomplete, when CrF_3 was partially reduced by hydrogen, and when CrF_2 was oxidized by HF or SnF_2. The compound forms green, translucent crystals that are biaxial (–) with refractive indices $N_\alpha = 1.518$ and $N_\gamma = 1.534$. (auth)

25341 HYDROLYSIS OF URANIUM CARBIDES BETWEEN 25 AND 100°. I. URANIUM MONOCARBIDE. Mildred J. Bradley and Leslie M. Ferris (Oak Ridge National Lab., Tenn.). Inorg. Chem., 1: 683-87(Aug. 1962). (ORNL-TM-38 and Rev.1)

High-purity uranium monocarbide, when allowed to react with water at temperatures between 25 and 99°, yielded a gelatinous, hydrous, tetravalent uranium oxide and a gas (93 ml (STP) per gram of UC hydrolyzed) consisting of 86 vol % methane, 11 vol % hydrogen, 1.8 vol % ethane, and small quantities of saturated C_3- to C_6-hydrocarbons. The gaseous products contained all the carbon originally present in the carbide. Hydrolysis, at 80°, of monocarbide specimens containing dispersed uranium metal yielded the expected gaseous products and an additional 2 moles of hydrogen per mole of uranium metal. The rate of hydrolysis was studied briefly. (auth)

25342 A NEW FAMILY OF RARE EARTH COMPOUNDS. I. Warshaw and Rustum Roy (Pennsylvania State Univ., University Park). Inorg. Chem., 1: 719-20 (Aug. 1962).

During a study of the phase equilibrium relations in rare earth sesquioxide-alumina systems, a rare earth compound having an oxide ratio of 2:1 and the general formula $A_4B_2O_9$ where A is rare earths and B is smaller trivalent cations. (M.C.G.)

25343 THE ELECTRODE POTENTIAL OF RUTHENIUM(IV) AND ITS LOWER OXIDATION STATES. Donald K. Atwood and Thomas de Vries (Purdue Univ., Lafayette, Ind.). J. Am. Chem. Soc., 84: 2659-61(July 20, 1962).

From titration data obtained for the reduction of ruthenium(IV) perchlorate with vanadium(II) sulfate, the electrode potentials of Ru(IV) and Ru(III) were calculated. The existence of a state with oxidation number 3.5 was confirmed. In the polarographic reduction of Ru(IV) in perchloric acid solutions three waves were observed and the dependence of the half-wave potentials on pH was determined. Both monomeric and polymeric Ru(IV) species were studied. (auth)

25344 CHLORINE ISOTOPE EFFECTS IN THE REACTIONS OF BENZYL AND SUBSTITUTED BENZYL CHLORIDES WITH VARIOUS NUCLEOPHILES. John W. Hill and Arthur Fry (Univ. of Arkansas, Fayetteville). J. Am. Chem. Soc., 84: 2763-9(July 20, 1962).

The kinetics and chlorine isotope effects in the nucleo-

philic substitution reactions of benzyl and substituted benzyl chlorides with water, cyanide ion, and thiosulfate ion were investigated. For those reactions exhibiting first-order kinetics, the kinetic isotope effect (k^{35}/k^{37}) observed was close to 1.0078, while for reactions displaying second-order kinetics the value was 1.0058. Those reactions proceeding by borderline kinetics gave isotope effects intermediate between these two extremes. Detailed analysis of the kinetic and isotope effect data for the reactions with cyanide and thiosulfate ions led to the conclusion that there is a smooth transition in the reaction mechanism from near ideal SN 1 to near ideal SN 2 as the electron-donating power of the substituent decreases. It appeared that the magnitude of the chlorine isotope effect may be used to differentiate between SN 1 and SN 2 reactions. (auth)

25345 INFRARED ABSORPTION SPECTRUM OF CD_4 AT 4500 cm^{-1}. K. Fox, K. T. Hecht, R. E. Meredith, and C. W. Peters (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 36: 3135-7(June 15, 1962).

A high-resolution infrared absorption spectrum is presented for the region of the first overtone of the triply degenerate vibrational fundamental ν_3 of CD_4. The measured lines between 4430 and 4550 cm^{-1} are reproduced and tabulated. Comparisons are made between the tetrahedral splittings in this spectrum and those in the spectra ν_3 and $\nu_1 + \nu_4$ of CH_4. (auth)

25346 MODIFIED UREY-BRADLEY FORCE FIELD FOR CONDENSED AROMATIC RINGS. James R. Scherer (Dow Chemical Co., Midland, Mich.). J. Chem. Phys., 36: 3308-21(June 15, 1962).

A modification of the basic Urey-Bradley force field which was previously shown to reproduce the planar vibrational spectra of benzene and substituted benzenes, was extended to naphthalene. An alternate modification based on MO theory was compared with the simpler Kekulé model, and both models are shown to lead to the same conclusions regarding the vibrational spectra. A zero-order calculation using thirteen force constants transferred from other molecules agreed remarkably well with the recent Scully-Whiffen and Freeman-Ross assignments. In the B_{2u} species, where these authors have serious differences, the modified UBFF favors the Scully-Whiffen assignment. A 16-parameter UBFF is refined to the H_8 and D_8 isotopes, and the vibrational frequencies of all deutero isotopes having V_h, C_{2v}, or C_{2h} symmetry are calculated with this potential function. (auth)

25347 MAGNETIC SUSCEPTIBILITY OF ReF_6. Henry Selig, Fred A. Cafasso, Dieter M. Gruen, and John G. Malm (Argonne National Lab., Ill.). J. Chem. Phys., 36: 3440-4 (June 15, 1962).

The magnetic susceptibility of ReF_6 was measured in the range 4 to 296°K using the Faraday method. The susceptibility in the range 14 to 296°K can be expressed by means of $\chi_{MXReF_6} = (78 \pm 1) \times 10^{-6}/T + (0.87 \pm 0.03) \times 10^{-6}$, from which one calculates a moment of 0.25 Bohr magnetons. Applying a theory developed for gaseous ReF_6 [W. Moffitt, G. L. Goodman, M. Fred, and B. Weinstock, Mol. Phys. 2: 109(1959)] to the magnetic measurements gave $\zeta = 3160$ cm^{-1} and $10\ Dq/\alpha = 55000$ cm^{-1}, where α is an orbital reduction parameter connecting the dt_{2g} and de_g levels. The diamagnetic susceptibility of WF_6 was remeasured and preliminary measurements on TcF_6 are reported. (auth)

25348 SECONDARY ISOTOPE EFFECTS IN MOLECULAR STRUCTURE. L. S. Bartell (Ames Lab., Ames, Iowa). J. Chem. Phys., 36: 3495-6(June 15, 1962). (IS-454).

A study was made to determine whether secondary isotope effects also occur in molecular structure. Electron diffraction studies were carried out on ethane and deuteroethane. In C_2H_6 the mean C−C and C−H bond lengths found agreed very closely with values determined for other paraffin hydrocarbons, and the C−H bond showed a normal primary isotope effect (~0.005 A) similar to that found in methane when H is replaced by O. The output of the least-squares analysis suggested that the mean C−C bond length in C_2D_6 is shorter than in C_2H_6 and by about 0.004 A. The decrease seemed to be real for the apparent uncertainty was not much greater than 0.001 A. (M.C.G.)

25349 IONIC CONDUCTIVITY OF ZIRCONIUM PHOSPHATE. R. P. Hamlen (General Electric Co., Schenectady, N. Y.). J. Electrochem. Soc., 109: 746-9(Aug. 1962).

Conductivity measurements were made on zirconium phosphate prepared using an excess of phosphoric acid and not subjected to high temperatures. Measurements were made of conductivity vs temperature. In order to determine the thermal stability of the zirconium phosphate, a thermogravimetric analysis was conducted. A fuel cell using a zirconium phosphate membrane was prepared, but the membrane had low conductivity and was changed by hydrolysis. (M.C.G.)

25350 THE MECHANISM AND KINETICS OF THE FORMATION OF $UO_{2.00} \cdot 6YO_{1.5}$. E. J. Felten and E. A. Aitken (General Electric Nuclear Materials and Propulsion Operation, Cincinnati). J. Inorg. & Nuclear Chem., 24: 35-43(Jan. 1962). (In English)

Above 1200°C four phases are present in the UO_2-Y_2O_3-O_2 system, namely; U_3O_8, a mixed oxide phase having the fluorite structure, a rhombohedral phase, and Y_2O_3. The fluorite phase was found to exist between 30 and 72.5 mole per cent $YO_{1.5}$. Between 74.5 and 81.0 mole per cent $YO_{1.5}$ the fluorite phase and the rhombohedral phase co-exist. The ideal composition of the rhombohedral phase is $UO_{2.00} \cdot 6YO_{1.5}$ (85.7 mole per cent $YO_{1.5}$). The rhombohedral phase is found between 81.0 and 87.7 mole per cent $YO_{1.5}$, and coexists with yttrium oxide between 87.7 and 95.6 mole per cent $YO_{1.5}$. X-ray diffraction methods were used to determine the mechanism and kinetics of the reaction between UO_2 or U_3O_8 and Y_2O_3 to form the rhombohedral phase. Between 1000 and 1100°C a fluorite phase having an approximate composition $UO_{2.00} \cdot 2YO_{1.5}$ is formed as an intermediate in the reaction with only a slow conversion to the rhombohedral phase. At 1200°C and above the formation of the rhombohedral phase proceeds more rapidly, going to completion in 8 hr or less at 1400°C. The x-ray diffraction data indicate good agreement with the Jander model for the formation of the rhombohedral phase. The reaction proceeds at least in part by diffusion of gaseous UO_3 to the surface of the Y_2O_3 particles. Further reaction involves bulk diffusion of uranium through the surface layer. An activation energy of 91 kcal/mole was obtained for the diffusion process. (auth)

25351 THE RELATIONSHIP BETWEEN THE SURFACE TENSIONS AND ENERGIES OF LIQUID METALS AND THEIR CRITICAL TEMPERATURES. A. V. Grosse (Temple Univ., Philadelphia). J. Inorg. & Nuclear Chem., 24: 147-56(Feb. 1962).

It is shown that a general relationship exists between the surface tension (σ) and surface energy (σ_A) of a liquid metal and its critical temperature (T_c) and atomic volume (V_A). The relationship (except for Hg, Cd, and Zn) is: $\sigma_A^o = \sigma^o \cdot V_A^{o\,2/3} = 0.64$ (ergs/gramme atom$^{2/3}$). T_c (in °K), where the superscript o refers to the extrapolated value at 0°K. (auth)

25352 REVALUATION OF THE CONTINUOUS VARIATION METHOD AS APPLIED TO THE URANYL AZIDE

COMPLEXES. F. G. Sherif and A. M. Awad (Alexandria Univ., Egypt). J. Inorg. & Nuclear Chem., 24: 179-82 (Feb. 1962). (In English)

The method of continuous variation is discussed critically, particularly when applied to solutions containing more than one complex. The deformations in the curves obtained can be interpreted by following the contours of these curves at different wavelengths and concentrations. The presence of mono-, di-, and tri-azido uranyl complex ions is revealed. (auth)

25353 ISOTOPIC EXCHANGE IN THE COBALTOUS–COBALTIC SYSTEM IN PERCHLORIC ACID. J. Shankar and B. C. de Souza (Atomic Energy Establishment, Trombay, India). J. Inorg. & Nuclear Chem., 24: 187-93(Feb. 1962). (In English)

Systematic investigations are reported on the isotopic exchange in the cobaltous-cobaltic system using cobalt-60. Ammonia and ethylenediamine were found to be satisfactory quenchers of this fast exchange, even though some zero-time exchange was observed. In the concentration range studied the reaction was found to be of the first order with respect to each reactant. At a high fixed ionic strength (3.1), variation of perchloric acid concentration from 0.25 to 0.7 F showed an inverse first-order dependence. Possible mechanisms for the exchange are discussed. (auth)

25354 ION EXCHANGE EQUILIBRIA IN THE PRESENCE OF ORGANIC SOLVENTS. I. THE INFLUENCE OF ORGANIC SOLVENTS ON THE DISTRIBUTION CONSTANT OF PRASEODYMIUM. C. Grigorescu-Sabău (Inst. for Atomic Physics, Bucharest). J. Inorg. & Nuclear Chem., 24: 195-203(Feb. 1962). (In English)

A systematic study was made of the influence of the addition of organic solvents on the distribution coefficients of praseodymium between the resin KU_2 in H-, NH_4-, Na-, and K-forms and solutions containing HCl, organic solvent, and H_2O. It was observed that the organic solvents do not influence the character of the reaction between cations and resin but only modify the value of the ion-exchange constants. (auth)

25355 CATALYTIC REACTIONS ON SEMICONDUCTORS: HYDROGEN-DEUTERIUM EXCHANGE AND FORMIC ACID DECOMPOSITION ON CHEMICALLY DOPED GERMANIUM. George E. Moore, Hilton A. Smith, and Ellison H. Taylor (Univ. of Tennessee, Knoxville and Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 1241-4 (July 1962).

Hydrogen–deuterium exchange and the decomposition of formic acid were studied from 100 to 400° over samples of germanium doped with 10^{18} to 10^{20} atoms per cc. of n- and p-type impurities. Over these wide ranges of electronic chemical potentials (Fermi level) and temperature the rate and activation energy of the exchange reaction varied definitely with the Fermi level. A minimum in the activation energy-Fermi level curve suggests a mechanism in which one step is rate-limiting on the n-type and a different one on the p-type side of intrinsic composition. Of the two paths for formic acid decomposition, only dehydrogenation seemed to be markedly affected by doping. (auth)

25356 THE CHLORIDE AND BROMIDE COMPLEXING OF SCANDIUM(III) AND YTTRIUM(III) IN AQUEOUS SOLUTION. Armine D. Paul (West Virginia Univ., Morgantown). J. Phys. Chem., 66: 1248-52(July 1962).

The chloride and bromide complexing of Sc^{+3} and Y^{+3} in perchlorate solution was studied potentiometrically using concentration cells containing silver–silver halide electrodes. At 25° and an ionic strength of 0.5M, the equilibrium quotients for the reactions $Sc^{+3} + Cl^- = ScCl^{+2}$, $ScCl^{+2} + Cl^- = ScCl_2^+$, $Sc^{+3} + Br^- = ScBr^{+2}$, $ScBr^{+2} + Br^- = ScBr_2^+$, $Y^{+3} + Cl^- = YCl^{+2}$, and $Y^{+3} + Br^- = YBr^{+2}$ were found to be 11.7, 10.9, 16.1, 3.3, 2.3, and 2.8, respectively. Equilibrium quotients also were determined at 15 and 35°. The stability of these complexes was compared with that of other trivalent ions. The first chloride complexes of Sc^{+3} and Y^{+3} were less stable than the corresponding fluoride and bromide complexes. (auth)

25357 SOLUTIONS OF ALKALI METALS IN ETHYLENEDIAMINE. Stanley Windwer and Benson R. Sundheim (New York Univ.). J. Phys. Chem., 66: 1254-8(July 1962).

The electron spin resonance spectra, optical absorption spectra, and electrical conductivities of solutions of alkali metals in ethylenediamine are reported. It was concluded that the species responsible for the spin resonance is the electron (rather than the monomer), and that the light absorption is due to the monomer and dimer. Variations in line width of the spin resonance absorption reveal that the electron is not completely independent of the ionic core. The optical absorption spectrum of rubidium is distinctly different from that of sodium or potassium. (auth)

25358 COMPLEX STRUCTURES IN AQUEOUS BINARY SALT SOLUTIONS. P. M. Duell and J. L. Lambert (Kansas State Univ., Manhattan). J. Phys. Chem., 66: 1299-1301 (July 1962).

The solutions investigated contained varying amounts of $ThCl_4$ in given concentrations of LiCl, NaCl, or KCl. Some evidence for complex formation was obtained from apparent molal and partial molal volumes determined as a function of concentration of $ThCl_4$. Diamagnetic susceptibilities had little usefulness in clarifying the nature of the solutions. (auth)

25359 PREPARATION, STRUCTURE, AND PROPERTIES OF K_2NbO_3F. Francis Galasso and Wilda Darby (United Aircraft Corp., East Hartford, Conn.). J. Phys. Chem., 66: 1318-20(July 1962).

An oxyfluoride, K_2NbO_3F with the K_2NiF_4 structure, was prepared. Unlike most compounds with this structure, K_2NbO_3F was found to have a c/a ratio greater than the calculated 3.41 value which satisfies the geometrical conditions of touching spheres. From a study of interatomic distances (obtained from single crystals), it was found that the high c/a ratio was related to an elongation of the anion octahedra in the "c" direction. The thermal coefficient of expansion for K_2NbO_3F was found to be more than twice as large in the "c" direction as in the "a" direction, a fact which may be responsible for the positive temperature coefficient of resistance exhibited by this material. (auth)

25360 FLUORINE BOMB CALORIMETRY. IV. THE HEATS OF FORMATION OF TITANIUM AND HAFNIUM TETRAFLUORIDES. Elliott Greenberg, Jack L. Settle, and Ward N. Hubbard (Argonne National Lab., Ill.). J. Phys. Chem., 66: 1345-8(July 1962).

The heats of formation of titanium and hafnium tetrafluorides were measured by direct combination of the elements in a combustion bomb calorimeter. The standard heats of formation, $\Delta Hf^\circ_{298.15}$, of titanium and hafnium tetrafluorides were found to be $-394.1_9 \pm 0.3_5$ and $-461.4_0 \pm 0.8_5$ kcal $mole^{-1}$, respectively. (auth)

25361 OXIDATION OF PHOSPHOROUS ACID. B. Silver and Z. Luz (Weizmann Inst. of Science, Rehovoth, Israel). J. Phys. Chem., 66: 1356-9(July 1962).

The oxidation and exchange reactions of phosphorous acid were reinvestigated in the strong acid range (up to 4.0N). The reaction was also studied at pH 8.6, where the dominant species of the phosphorous acid is the dianion HPO_3^{-2}. The exchange of the phosphorous-bonded hydrogen

of H_3PO_3 with solvent D_2O could be observed only in strong acid and was studied by a nuclear magnetic resonance technique. Oxidation by iodine was followed by titration of iodine with thiosulfate solution. In the acidic range the results suggest that tautomerism plays a role in the oxidation reaction. It was also concluded that the oxidation is acid-catalyzed and that at 1.0N HCl the initial rate is not linearly proportional to iodine concentration. (M.C.G.)

25362 THE REACTIONS OF ACTIVE NITROGEN WITH $N^{15}O$ AND N_2^{15}. R. A. Back and J. Y. P. Mui (National Research Council Labs., Ottawa). J. Phys. Chem., 66: 1362-4(July 1962).

The reaction of active nitrogen with $N^{15}O$ was studied to determine if the reaction $N + NO \rightarrow N_2 + O$ (1) is the only important one. If, however, the reaction ($N_2 + NO \rightarrow N_2 + N + O$ (2) occurs, free N^{15} atoms would be produced. A comparison was made of the reactions of active nitrogen with C_2H_4 and NO. It was found the $N^{15}O$ consumed in reaction with active nitrogen is quantitatively converted to $N^{15}N^{14}$, with almost no N_2^{15}. The exchange reaction of isotopically-natural active nitrogen with N_2^{15} was examined at 30 to 1000°C. No measurable exchange was detected. (M.C.G.)

25363 SOLUTION PROPERTIES OF POLYBUTADIENE AND TRANSPOLYISOPRENE FRACTIONS. W. Cooper, D. E. Eaves, and G. Vaughan (Dunlop Research Centre, Birmingham, Eng.). J. Polymer Sci., 59: 241-57(June 1962).

Linear polybutadienes, prepared with butyllithium as catalyst, and polybutadienes branched by exposure to γ radiation were fractionated and the fractions examined by osmometry and light scattering. Turbidimetric second virial coefficients (A_2^τ) of mixed polymer fractions were virtually the same as those of the higher molecular weight components of the mixtures for most compositions. This was true both for mixtures of linear with linear and linear with branched polymer. The higher the molecular weight of the fraction, the greater the effect; the addition of 1% microgel to a linear polymer reduced A_2^τ by a factor of three. The presence of microgel or high molecular weight branched polymer was shown to be responsible for the very high molecular weights previously reported for polybutadienes from light scattering measurements. It can be removed by shaking the solutions with calcium sulfate. Second virial coefficients obtained either by light scattering or osmometry were, within the limits of experimental error, uninfluenced by branching in the polymer. In general those factors which led to increased branching also resulted in increased polydispersity, and it was the latter which resulted in the decrease in A_2^τ. The fall of the osmotic second virial coefficient (A_2^π) with molecular weight was much smaller than would be calculated theoretically, and the fall in A_2^τ was greater than would be expected, notwithstanding the fact that for some of the fractions $\bar{M}_w/\bar{M}_n < 1.1$. This indicated that A_2^π is sensitive to the low molecular weight species present in the fractions, whereas the reverse must apply to A_2^τ. Natural or synthetic trans-polyisoprene showed analogous behavior to polybutadiene, although, owing to experimental difficulties, sharp branched fractions could not be obtained. The following viscosity-molecular weight relationships were obtained in benzene solution: $[\eta] = 1.45 \times 10^{-4}M^{0.76}$ for butyllithium-catalyzed polybutadienes, and $[\eta] = 4.37 \times 10^{-4}M^{0.65}$ for natural and synthetic trans-polyisoprenes. (auth)

25364 ADSORPTION OF QUADRIVALENT URANIUM TO HUMIC SUBSTANCES. Ernő Bruecher. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 3: 11-15(Apr. 1961). (In Hungarian)

The adsorption of quadrivalent uranium by humic substances was studied. Quadrivalent uranium was found to be adsorbed even more than hexavalent uranium. (auth)

25365 ACID LEACHING OF THORIUM CARBIDE. Yasuichi Sasaki, Fujio Ichikawa, Hisashi Imai, and Shinobu Uruno (Japan Atomic Energy Research Inst., Ibaraki-ken). Nature, 195: 267-8(July 21, 1962).

Overnight acid leaching experiments were carried out on ThC_2 with HCl, H_2SO_4, and HNO_3. For 0.5 to 12 N HCl at room temperature, ThC_2 disintegrated spontaneously and dissolved 100%. For H_2SO_4 at room temperature, ThC_2 dissolved 100% in 0.5 to 3 N, but at higher concentrations, the solubility decreased to zero. At 80° C in 12 N H_2SO_4, however, the solubility increased to 6.1%, as compared with 1.8% at room temperature. For HNO_3 at room temperature, the solubility decreased from 100% in 0.5 N to a minimum in 6 N and thereafter increased to a limit of 50% in 12 N. The solubility in 8 N HNO_3 increased from 19% at room temperature to 99% at 80° C. A mechanism for the redissolving of ThC_2 in HNO_3 at concentrations above 6 N is proposed. (D.L.C.)

25366 MAGNETIC AND NEUTRON DIFFRACTION STUDY OF THE Fe_2O_3–V_2O_3 SYSTEM. D. E. Cox, W. J. Takei, R. C. Miller, and G. Shirane (Westinghouse Research Labs., Pittsburgh). Phys. and Chem. Solids, 23: 863-74(July 1962). (In English)

An investigation of the magnetic properties and structure of the rhombohedral Fe_2O_3–V_2O_3 system is described. Almost complete solid solution exists at 1000°C. The magnetic behavior up to a V_2O_3 content of 40% resembles that of α-Fe_2O_3, a weak spontaneous moment appearing at the Néel temperature. Between 40 and 80% V_2O_3, there is weak ferrimagnetism reaching a maximum value of about 0.2μ_B per formula unit at 65% V_2O_3. Between 85 and 100% V_2O_3, the properties resemble those of V_2O_3. A neutron diffraction study showed that the hematite magnetic structure exists up to 60% V_2O_3 but that at 70% V_2O_3, the order is more short-range in nature. The transition from long-range to short-range order is apparently quite continuous. This is discussed with reference to the idea of direct V^{3+}–V^{3+} interactions as advanced by Goodenough. The weak ferrimagnetism is attributed to cation order of ilmenite type, similar to that observed in the Fe_2O_3–$FeTiO_3$ system, but present only to a small degree in Fe_2O_3–V_2O_3. (auth)

25367 THE SPECIFIC HEAT OF GADOLINIUM SULPHATE: A NEW APPRAISAL. G. S. Bogle and W. Toutenhoofd (Commonwealth Scientific and Industrial Research Organization, Sydney). Proc. Phys. Soc. (London), 80: 230-7(July 1, 1962).

The Schottky specific heat anomaly of gadolinium sulfate octohydrate is calculated from microwave measurements of the ground-state splittings. The results are tabulated for a number of temperatures between 0.05 and 4.0°K, together with values of the partition function and entropy. The agreement with measurements of specific heat is good provided that the $S_z = \pm 1/2$ state of the multiplet is lowest in energy, or, in other words, that the coefficient of S_z^2 in the spin Hamiltonian is positive. (auth)

25368 INVESTIGATIONS OF THE COMPLEX COMPOUNDS IN THE SOLUTIONS BY THE METHOD OF PARTITION. A. P. Zozulja and W. M. Pieszkowa. Wiadomości Chem., 16: 145-93(Mar. 1962). (In Polish)

Achievements of investigations in the field of complex compounds in solutions by method of partition are discussed. The theoretical basis of the investigations as well as the analysis of the experimental results concerning contents and other physicochemical properties of the

complex compounds in the solutions obtained by the method of partition are given. 264 references are included. (auth)

25369 CONCERNING AROMATIC COMPLEXES OF METALS. LVII. URANIUM TETRACYCLOPENTADIENYL. Ernst Otto Fischer and Yani Hristidu (Universität Munich). Z. Naturforsch., 17b: 275-6(Apr. 1962). (In German)

The preparation of $U(C_5H_5)_4$ was carried out by double decomposition of UCl_4 with an excess of KC_5H_5 in benzene. The structure and properties were studied. (M.C.G.)

25370 CONCERNING THE AROMATIC COMPLEXES OF METALS. LIX. THORIUM TETRACYCLOPENTADIENYL. Ernst Otto Fischer and Arno Treiber (Universität Munich). Z. Naturforsch., 17b: 276(Apr. 1962). (In German)

$Th(C_5H_5)_4$ was prepared by the reaction of $ThCl_4$ with an excess of KC_5H_5 in diethylether. The properties and structure were studied. (M.C.G.)

25371 DETERMINATION OF VAPOR PRESSURE OF URANIUM COMPOUNDS. V. E. Ivanov, A. A. Kruglykh, V. S. Pavlov, G. P. Kovtun, and V. M. Amonenko. Preprint SM-26/60. 10p. (In Russian)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The evaporation rate of intermetallic USn_3 was measured at 1025 to 1295°C. A complete dissociation was observed at 1000°C. At identical temperatures the U vapor pressure is lower than that of tin. Evaporation data are found for the dissociation pressure with one volatile component (considering the molecular weight of a single tin atom. The equation for USn_3 dissociation at 1025 to 1295°C is lg $P_{mm} = 9.067 - (17223/T)$. Diagrams of UO_2 and USn_3 vapor pressures as functions of temperature are given. The heat of sublimation is 78.8 kcal/mole. The evaporation rate of UO_2 measured in a tantalum crucible at 1650 to 1930°C was lg $P_{mm} = 12.098 - (32150/T)$; the heat of evaporation of UO_2 is 143 kcal/mole. (R.V.J.)

25372 ISOTOPIC EXCHANGE AND THE REPLACEMENT OF HYDROGEN IN ORGANIC COMPOUNDS. A. I. Shatenshtein. Authorized translation from the Russian by C. Nigel Turton and Tatiana I. Turton. New York, Consultants Bureau, 1962. 323p.

The mechanisms of hydrogen replacement reactions, especially hydrogen isotope exchanges, were examined. The mechanisms were interpreted from the point of view of the acid-base properties of the reagents. Topics covered include: types of reagents and reactions, acid-base catalysis of hydrogen exchange, hydrocarbons as acids and bases, mechanism of acid-base interaction, and mechanism of hydrogen replacement reactions. (M.C.G.)

25373 EQUILIBRIUM MEASUREMENTS AND INTERPRETATION OF NON-STOICHIOMETRY IN UO_{2+x}. E. Aukrust, T. Forland, and K. Hagermark (Norges Teknisk-Naturvitenskapelige Forskningsrad and Norges Tekniske Hogskole, Trondheim, Norway). Preprint SM-26/1. 21p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Equilibrium oxygen pressures over non-stoichiometric uranium dioxide with and without additions of yttrium oxide were determined at 1100 to 1400°C over the composition range $UO_{2.000}$ to $UO_{2.600}$, but particularly in the range near stoichiometric UO_2. The non-stoichiometry x was determined by a thermobalance. At oxygen pressures between 10^{-14} and 10^{-3} gas mixtures of CO_2 and CO were used, and at oxygen pressures between 10^{-1} and 10^{-3} gas mixtures of Ar and O_2 were used. The results for the system UO_{2+x} are in accordance with data reported earlier. The experimental data give information about defect structure and phase relations. (auth)

25374 FREE-ENERGY- AND PHASE-DIAGRAMS. O. Kubaschewski (National Physical Lab., Teddington, Eng.). Preprint SM-26/3. 39p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The stability of every intermediate phase in a given system is determined by its free-energy versus concentration curve. Free energies can therefore be estimated from established equilibrium diagrams. This method is frequently being used by metallurgists. In the long run the reverse procedure is probably more important, that is, the calculation of equilibrium diagram from experimental heats and entropies of formation of the various phases. This mutual connection is discussed and demonstrated with the aid of examples pertaining to metals of interest in atomic energy. (auth)

25375 STUDY OF URANIUM BORIDES AND CARBIDES BY MEANS OF THE KNUDSEN EFFUSION TECHNIQUE. C. B. Alcock and P. Grieveson (Royal School of Mines, London). Preprint SM-26/6. 19p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The free energies of formation of the borides UB_2, UB_4, and UB_{12}, and the carbides UC and UC_2 were obtained from a series of experiments based on Knudsen's effusion technique for the measurement of vapor pressures. Three different experimental procedures were used to obtain uranium activities in these systems. From these measurements, values could be obtained for the uranium activities across the whole composition range in the alloys, and by making the assumption that the compounds do not depart substantially from the stoichiometric composition, integral free energy of formation diagrams for the U–B and U–C systems were obtained at several temperatures. The diagrams immediately show the greater stability of the borides of uranium when compared with the carbides. The following two-term free energy equations for the formation of one mole of compound from liquid uranium and solid carbon or boron were obtained: UC $\Delta G^0 = -25{,}200 + 3.6\ T$ cal/mole of compound. UC_2 $\Delta G^0 = -32{,}600 + 3.6\ T$ cal/mole of compound. UB_2 $\Delta G^0 = -39{,}300 + 3.0\ T$ cal/mole of compound. UB_4 $\Delta G^0 = -60{,}400 + 4.4\ T$ cal/mole of compound. UB_{12} $\Delta G^0 = -106{,}000 + 10.5\ T$ cal/mole of compound. By combining these results with earlier work, the sequence of stabilities borides > carbides > silicides > aluminides was established for uranium compounds. No evidence was found for the formation of extensive solid solutions between the phases which were studied in these experiments, nor was the presence of a phase U_2C_3 markedly more stable than a $UC–UC_2$ mixture indicated by these results. (auth)

25376 EXPERIMENTAL EQUATION OF STATE DATA FOR URANIUM AND ITS INTERPRETATION IN THE CRITICAL REGION. I. C. Skidmore and E. Morris (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Preprint SM-26/8. 61p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The thermodynamic properties of natural uranium at pressures of a few kilobars and specific internal energies

of several kilojoules per gram are of importance to reactor safety calculation. Such states may be attained by the irreversible heating associated with a strong shock compression to a pressure of a few megabars followed by an adiabatic expansion to low pressures. Experiments are described where high explosives were used to induce such pressures and maintain the states of interest for times of a few tenths of microseconds. The uranium samples were in the form of porous compacts of about half normal density to increase the irreversible heating effect. The dynamic variables associated with the hydrodynamic processes were measured and interpreted in terms of the thermodynamic properties of the material. At the lowest pressures, around 1 kilobar, the data appear anomalous and interpolation is difficult. A more refined interpretation of the low pressure data is presented where the effect of phase transitions and also the trapped air in the uranium on the hydrodynamic processes is considered. The results suggest that Brout's calculations on the thermodynamics of uranium in the critical region, based on corresponding state considerations, are valid if an "electronic" contribution is added to his energy values. (auth)

25377 THERMODYNAMIC DATA FOR THE URANIUM OXIDES BETWEEN UO_2 AND U_3O_8. T. L. Markin, L. E. J. Roberts, and A. J. Walter (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Preprint SM-26/9. 24p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The pressure of oxygen in equilibrium with uranium oxides of composition $UO_{2.09}$ to $UO_{2.4}$ at temperatures of 1000 to 1450°C was measured by a tensimetric technique. Equilibrium data were also obtained for oxides of composition between $UO_{2.01}$ and $UO_{2.6}$ by measurements made with galvanic cells between 500 and 1060°C. These measurements are combined and compared with other values in the literature. The variation of partial molal quantities with composition in the non-stoichiometric regions and the composition limits of the various phases as a function of temperature are calculated. Other attempts to determine the phase diagram are reviewed. The energy and entropy changes on the formation of the U_4O_9 phase from the UO_{2+x} phase are calculated and shown to be consistent with a high degree of ordering in the U_4O_9 phase relative to the UO_{2+x} phase. The evidence on the nature of the tetragonal uranium oxides is reviewed briefly. (auth)

25378 THE HEAT OF FORMATION OF U_3O_7. T. Mukaibo, K. Naito, K. Sato, and T. Uchijima (Japan Atomic Energy Research Inst., Tokyo). Preprint SM-26/10. 18p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

U_3O_7 is formed during the oxidation of UO_2 and is known as the metastable intermediate. The oxidation of UO_2 in air takes place as the following: $UO_2 + \frac{1}{6}\ O_2 \rightarrow \frac{1}{3}\ U_3O_7$ at 230°C; $\frac{1}{2}\ U_3O_7 + \frac{1}{6}\ O_2 \rightarrow \frac{1}{3}\ U_3O_8$ at 380°C. These heats of oxidation at each reaction temperature were obtained by the differential thermal analysis method and the specific heat measurement method. The specific heat of U_3O_7 itself was also measured above the room temperature, and the heat of formation of U_3O_7 was determined. (auth)

25379 THE MEASUREMENT OF THE SPECIFIC HEAT OF URANIUM CARBIDES ABOVE ROOM TEMPERATURE. T. Mukaibo, K. Naito, K. Sato, and T. Uchijima (Japan Atomic Energy Research Inst., Tokyo). Preprint SM-26/11. 10p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Pure uranium monocarbide and dicarbide were prepared by solid phase reaction from uranium hydride and carbon. The specific heats of these samples were measured above the room temperature and are given as function of temperature. (auth)

25380 STATISTICO-THERMODYNAMICAL STUDY OF THE EQUILIBRIUM BETWEEN HYDROGEN GAS AND PLUTONIUM DIHYDRIDE PHASE. S. Takeuchi and K. Suzuki (Tohoku Univ., Sendai, Japan). Preprint SM-26/13. 19p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The thermodynamical equilibrium between hydrogen gas and nonstoichiometric plutonium dihydride phase was investigated theoretically. The hydrogen pressure-composition isotherms for plutonium-hydrogen system were studied experimentally by R. N. R. Mulford, et al. (J. Am. Chem. Soc., 77: 3499(1955); 78: 3867(1956)). It was known from these isotherms that plutonium dihydride phase is a berthollide compound which exists in the concentration range with positive and negative deviations from stoichiometric composition. The plutonium dihydride phase of composition H/Pu = 2 has the fluorite structure, plutonium atoms occupy the face-centered cubic lattice sites in this structure, and hydrogen atoms are located in the tetrahedral sites of the plutonium lattice. By the theoretical investigation on the isotherms it was verified that in the composition range of H/Pu < 2 all of the hydrogen atoms occupied the tetrahedral sites but there remain unoccupied sites. According to the results of the neutron diffraction on the rare earth metal deuteride having isomorphism with the fluorite structure performed by C. E. A. Holley, et al. (J. Phys. Chem., 59: 1226(1955)), it is considered that in the composition range of H/Pu > 2 the excess hydrogen atoms occupy the octahedral sites in the face-centered cubic lattice of plutonium. In the vicinity of stoichiometric composition, hydrogen atoms can be considered to occupy both sites of tetrahedron and octahedron. The ratio of hydrogen atoms in both sites depends upon the hydrogen concentration and the difference between the energies necessary to locate hydrogen atoms in the tetrahedral and octahedral sites. Based on the model described above, the absolute activity of hydrogen atoms in nonstoichiometric plutonium dihydride phase was calculated statistico-thermodynamically and the equilibrium hydrogen pressure in the full range of composition was obtained in relation to temperature. These results were in good agreement with the experimental isotherms observed by Mulford, et al. (auth)

25381 VOLATILE OXIDES OF SOME IMPORTANT MATERIALS USED IN NUCLEAR TECHNOLOGY. E. H. P. Cordfunke (Reactor Centrum Nederland, Petten, Netherlands). Preprint SM-26/16. 17p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A survey is given of data available at present on the volatile oxides of some important materials used in nuclear technology. A short description is given of the main experimental methods for identifying the volatile species and the accuracy of these methods, briefly illustrated with some examples. Next, attention is given to the formation of the volatile oxides of uranium and plutonium. Finally, some other materials are discussed, mainly refractory

oxides, such as alumina, silica, zirconia a.o. As far as possible, free energy equations and graphs are presented which permit the elucidation of the thermodynamics of the volatile oxides. (auth)

25382 SOME ASPECTS OF IRREVERSIBLE THERMODYNAMICS. I. Prigogine and R. Balescu (Université Libre, Brussels). Preprint SM-26/17. 7p. (In English)

To be published in the Proceedings of the IAEA Symposoum on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A short review of the methods of linear nonequilibrium thermodynamics is given. The Onsager reciprocity relations and their utility are discussed. The concept of entropy production and the variational principles associated with it are emphasized. An account is given of some recent work dealing with more complicated nonlinear problems, such as non-Newtonian flow. It is shown that variational principles can be derived which are valid in some very general cases. These principles can be used for an approximate computation of the properties of the stationary state in situations where the exact solution of the equations of motion is hopelessly complicated. (auth)

25383 THERMODYNAMIC STUDY OF THE THORIUM PHOSPHIDES WITH A MASS SPECTROMETER. K. A. Gingerich and J. Efimenko (National Bureau of Standards, Washington, D. C.). Preprint SM-26/19. 14p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The vaporization of phosphides is being investigated using a mass spectrometer with a Knudsen effusion cell. For the system Th–Th_3P_4, the ion intensity variation with temperature and composition was obtained for the vapor species. No molecules containing both thorium and phosphorus were observed in the vapor below 2150°K. With the aid of a silver calibration, the ion intensities were related to the partial pressures of the effusing vapor species. From these data, the partial molar heats of formation and free energies of formation were determined with reference to gaseous P_2. The heat of formation for Th_3P_4 at 1200°K was found to be 83 kcal. The thermodynamic stability of the thorium phosphides increases significantly with decreasing phosphorus content. The temperatures corresponding to a partial molar free energy of formation of –25 kcal at the composition $ThP_{1.34}$, $ThP_{0.4}$ and $ThP_{0.1}$ are 1050, 1750 and 2100°K respectively. At the temperatures of investigation, there exist extensive solid solutions in the composition range Th–ThP. The thermodynamic stability of the thorium phosphides is compared with that of selected lower phosphides of transition metals. (auth)

25384 THERMODYNAMIC PROPERTIES OF ZIRCONIUM–OXYGEN, TITANIUM–OXYGEN AND HAFNIUM–OXYGEN ALLOYS. A. Veinbachs, K. Komarek, and M. Silver (New York Univ., New York). Preprint SM-26/22. 34p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Thermodynamic properties (partial molar free energies, enthalpies and entropies) of oxygen in solid titanium–oxygen, zirconium–oxygen, and hafnium–oxygen alloys were determined from 0 to 30 at. % oxygen in the temperature range between 800 and 1000°C by equilibrating thin titanium, zirconium, and hafnium specimens with alkaline earth metal vapors of known partial pressure and solid alkaline earth metal oxides. The metal specimens were placed in a temperature gradient in an evacuated and closed tube in close physical contact with the oxide. The corresponding metal was kept at the lowest temperature on the bottom of the vertical tube, which was heated in a vacuum system until equilibration was achieved. In equilibrium, the specimens contained oxygen of the same partial pressure as that given by the known equilibrium between the earth alkaline metal and its oxide. By determining the weight increase of the specimens and their lattice parameters, the oxygen content was obtained and the thermodynamic properties of oxygen in these alloys were calculated. The partial molar free energy of oxygen in the range of solid solution in these alloys drops, first slowly, then exponentially to more negative values than those for zirconium which, in turn, are more negative than that for titanium, i.e., the affinity of oxygen increases from titanium, to zirconium, to hafnium. In dilute solutions, the partial molar entropy of oxygen can be expressed by a statistical model assuming random distribution of oxygen atoms over the octahedral interstices in the hexagonal close-packed structure. The partial molar enthalpy of oxygen in dilute solutions is constant. The solubility of magnesium and calcium in zirconium, titanium, and hafnium is small and the activities of magnesium and calcium show strong positive deviations from Raoult's law. (auth)

25385 THE VOLATILITY OF PLUTONIUM CARBIDE. Robert N. R. Mulford, John O. Ford, and Joseph G. Hoffman (Los Alamos Scientific Lab., N. Mex.). Preprint SM-26/25. 26p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Results of measurements of the vapor pressure of plutonium carbide in the presence of excess graphite are presented. The measurements were made by the Knudsen effusion technique in the temperature range 2000 to 2500°K. High temperature thermodynamic functions for plutonium carbide are derived from the experimental data. Experiments designed to obtain information concerning the vaporization processes of plutonium carbides are also described. The data indicate that carbon-containing gaseous species may exist in the equilibrium vapor. This information complements the vapor pressure measurements and provides a basis for the thermodynamic analysis. (auth)

25386 THERMODYNAMICS OF VAPORIZATION OF THE RARE EARTH OXIDES AT ELEVATED TEMPERATURES; DISSOCIATION ENERGIES OF THE GASEOUS MONOXIDES. D. White, P. N. Walsh, L. L. Ames, and H. W. Goldstein (Ohio State Univ., Columbus). Preprint SM-26/27. 40p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A review of the thermodynamics of decomposition of the solid oxides in the lanthanide series including yttrium, at temperatures in the range 1900 to 2700°K is presented. The experimental techniques used in the investigation are discussed and the experimental results presented in detail. These include: (1) The mass spectrometric determination of the vapor species in equilibrium with the solid oxides at elevated temperatures; (2) The investigation of rates of vaporization of the solid oxides at elevated temperatures by the Knudsen effusion method; (3) x-ray diffraction studies of quenched oxide samples after partial vaporization; (4) Mass spectrometric determination of the thermodynamics of the vapor phase oxygen exchange reac-

tions $M_1O(g) + M_2(g) \rightleftharpoons M_2O(g) + M_1(g)$ where M_1, M_2 refer to two different rare earths to establish the dissociation energies of the gaseous rare earth monoxides. The stable vapor species in equilibrium with the solid oxides in the lanthanides are with three exceptions found to be MO(g), M(g), and atomic oxygen. The three exceptions occur in the vaporization of $CeO_2(s)$, $Pr_6O_{11}(s)$, and $Tb_4O_7(s)$ where, in addition to the vapor species already mentioned, $CeO_2(g)$, $PrO_2(g)$, and $TbO_2(g)$ respectively are also found. The solid sesquioxide phases in equilibrium with these vapor species is found to be nearly always oxygen deficient of stoichiometry $M_2O_{3-x}(s)$. The dissociation energies of the gaseous monoxides of the lanthanides are found to exhibit periodicities with atomic number similar to those observed in the heat of sublimation of the metals. The dissociation energies decrease from lanthanum to europium, increase abruptly at gadolinium, then decrease again to ytterbium and rise abruptly again at lutetium. The volatility of the solid sesquioxides at elevated temperatures is discussed in detail from the thermodynamic standpoint, certain correlations pointed out, and some preliminary explanations for the observed variations with atomic number are presented. (auth)

25387 THERMODYNAMICS OF THE URANIUM–BISMUTH SYSTEM. P. A. Rice, R. E. Balzhiser, and D. V. Ragone (Univ. of Michigan, Ann Arbor). Preprint SM-26/28. 22p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Thermodynamic activities across the U–Bi system were investigated from 1018 to 1115°K by measuring equilibrium, and bismuth-vapor pressures and from 873 to 1273°K by considering uranium dicarbide dissociation in bismuth. Relative bismuth vapor pressures above U–Bi solution were measured by an optical absorption technique which allowed the independent determination of the Bi and Bi_2 vapor species. Measurement of the uranium concentrations resulting from the reaction: $UC_2 = 2C + \underline{U}$ (in bismuth) yields a value of the thermodynamic activity coefficient of dilute U in bismuth if a value of free energy of formation of UC_2 is assumed. The data can be used to calculate the free energy of formation of UC_2 if values of uranium activity in bismuth are considered reliable. (auth)

25388 CHEMICAL THERMODYNAMICS OF THE ACTINIDE ELEMENT CHALCOGENIDES. E. F. Westrum, Jr. and F. Grønvold (Univ. of Michigan, Ann Arbor). Preprint SM-26/30. 70p.

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Extant experimental heat capacities at low and high temperatures, bomb calorimetric, and thermochemical data on the actinide element chalcogenides (i.e., oxides, sulfides, selenides, and tellurides) are collected, organized, correlated, and critically analyzed with respect to other physico-chemical evidences (such as phase diagrams, reactivity, equilibrium data, magnetic susceptibilities, etc.) having a bearing on these systems. The most extensive data concern the thermal properties and Gibb's energies of the uranium oxides. Recent low temperature heat capacity studies of Westrum and Grønvold permit an understanding of the stability of the uranium dioxide (UO_2), triuranium octaoxide (U_3O_8), uranium trioxide (UO_3) and the metastable phases produced by low temperature oxidation (α- and β-triuranium heptaoxides, both possessing tetragonally deformed UO_2-type structures) as well as other metastable intermediate phases. The extension to thorium dioxide, neptunium dioxide, and other actinide oxides is examined. Unpublished data on the low temperature heat capacities and thermodynamic properties of uranium di- and trisulfides (and possibly the monosulfide) are presented and analyzed. Through extensive (unpublished) measurements and a critical review of the available entropies of chalcogenides throughout the periodic system, Grønvold and Westrum have provided a method for the estimation of the entropies of such substances for which thermal data do not exist. This novel approach which has proven successful in correlating the thermodynamics of the transition element chalcogenides is a modification of Latimer's scheme in which variation in entropy for various compounds of a metal are assigned to the anion present; but in addition, special structural features, magnetic and electronic contributions are also taken into account. The method is applied to evaluate entropies for the sulfides, selenides, and tellurides of the actinide elements on which experimental data are lacking. Finally, the bearing of the results of extensive measurements on the thermal properties and Schottky energy levels of the lanthanide sesquioxides on the thermodynamics of the related actinide element chalcogenides is discussed. Application of these data to practical problems in the chemistry of nuclear materials is also treated briefly. (auth)

25389 VAPORIZATION PROCESSES OF REFRACTORY SUBSTANCES. P. W. Gilles (Univ. of Kansas, Lawrence). Preprint SM-26/31. 22p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

In addition to providing the vapor pressure data necessary for the calculation of vaporization loss, the study of vaporization processes also has many other purposes. Such research serves to establish the nature and energetics of chemical binding in the gaseous state; to establish the nature of high temperature reactions; to measure the thermodynamic properties of solids, liquids and gases; to study the kinetics of high temperature reactions; and to prepare new substances. Many of the data required for the testing of the theories of chemical binding come from high temperature vaporization studies. A discussion is given of the physical chemical principles involved in the study of vaporization processes. Usually the study of a vaporization process proceeds through six stages: (1) the general behavior of the system is established; (2) the gaseous species are identified; (3) the net reaction is deduced; (4) the vapor pressure is measured; (5) the kinetics of the evaporation process may be measured; and (6) finally the detailed mechanism of the vaporization process can be established. Most of the present studies in connection with vaporization processes are in the first four stages. The methods for studying these stages of vaporization processes are discussed and illustrated by reference to particular refractory binary and ternary chemical systems. (auth)

25390 STATISTICAL THERMODYNAMICS OF FUSED SALTS. Howard Reiss (Atomics International, Canoga Park, Calif.). Preprint SM-26/36. 22p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Recent advances in the statistical thermodynamic theory of fused salts are discussed. These advances make very little use of models and are "first-principle" theories except for some simple and well defined approximations.

Among the things which were accomplished are a law of corresponding states for fused salts, a theory of the heats of mixing of fused salt mixtures, expressions for the surface tensions of fused salts, and a calculation of the compressibilities. (auth)

25391 THERMODYNAMICS OF SOLUTIONS OF ACTINIDES AND FISSION PRODUCTS IN BISMUTH. Richard H. Wiswall, Jr. and James J. Egan (Brookhaven National Lab., Upton, N. Y.). Preprint SM-26/37. 36p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A review is presented on all the published work on the thermochemistry of the liquid alloys of bismuth with Th, Pa, U, and Pu and the high-yield fission products, and all the authors' own results in this field are given. The latter, hitherto published only in summary, were obtained chiefly from measurements on galvanic cells, of which the following is illustrative: U (s) | LiCl–KCl (eut) + 5% UCl_3 (l) U–Bi(l). The free energies, and in some cases the enthalpies and entropies, of mixing were obtained for dilute solutions of Ce, U, Th, and Zr in bismuth. Less precise but still significant information on the properties of Sm, La, Nd, Tc, Te, Ru, Rh, Pd, Pa, Po, Cs, and Ba in bismuth was obtained from experiments on their distribution between liquid metal and fused salt phases or between two liquid metals. The Brookhaven results are correlated with those obtained elsewhere, and an attempt is made to establish a self-consistent set of data. (auth)

25392 THE STANDARD MOLAR FREE ENERGY OF FORMATION OF SOME CHLORIDES OF Mg, Ce, U AND Th BY SOLID STATE EMF TECHNIQUES. J. J. Egan, W. McCoy, and J. Bracker (Brookhaven National Lab., Upton, N. Y.). Preprint SM-26/38. 14p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The method is applied to study the free energy of formation of chlorides using Daniell cells where all components are solid. A typical cell may be represented as follows: Ce, $CeCl_3$(S)/$BaCl_2$(s)/$\frac{AgCl}{NaCl}$ 20 M% (s)/Ag, where the over-all cell reaction is Ce + AgCl(NaCl) = $CeCl_3$ + Ag. All cells were constructed so that adjacent phases exhibited negligible mixing as shown by the phase diagrams. In this way junction potentials were eliminated. The effect of metal-salt reactions (subhalide formation) on the cell behavior is discussed. The experimental techniques used are presented, including cell construction, preparation of anhydrous materials, and the handling of reactive metals and hydroscopic materials for galvanic cells. Results of ΔF^0 of formation are presented for $MgCl_2$, $CeCl_3$, UCl_3, and $ThCl_4$ between 400 and 600°C and are compared with other available data. The precision and limits of accuracy are discussed. (auth)

25393 VAPORIZATION STUDIES OF THE URANIUM DICARBIDE PHASE. Harry A. Eick (Michigan State Univ., East Lansing), E. G. Rauh, and R. J. Thorn. Preprint SM-26/39. 12p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

From a measurement of the absolute effusion rates of uranium, its partial pressures in equilibrium with uranium dicarbide and carbon were determined over the temperature range 2060 to 2820°K. The dicarbide phase was prepared by the reaction of uranium dioxide with graphite in a graphite cup which also served as a liner in the tantalum effusion cell. In preliminary studies it was found that the sample was easily contaminated with oxygen which caused an abnormally high volatility. Extensive heating of the sample in a vacuum of about 10^{-6} mm Hg removed this oxygen. Chemical analyses of a melted sample established the composition as $UC_{1.99}$. About one per cent of the effusing gaseous uranium (in all its forms) was condensed on platinum collectors which were analyzed by alpha-counting of either the U^{233} or U^{235} isotope. Mass spectrometric studies indicated the effusate contained gaseous uranium, monatomic and triatomic carbon, and uranium dicarbide; the ratio of U^+ to UC_2^+ was 4 at about 2800°K. Within the precision of the present study the gaseous dicarbide may be neglected in the pressure calculations. The plot of log p vs. 1/T may be characterized as two nearly parallel linear regions, one observed at lower and the other at higher temperatures. Points on the higher temperature line differ by a factor of 1.1 from points on an extrapolation of the other line; a gradual transition region exists between the two. The precise behavior is obscured by an error which exceeds the expected random experimental error and which may be caused by a changing composition of the dicarbide phase. The two lines describing the data are: log p(atm) = –34,568/T + 7.01 (2060 to 2460°K) and log p(atm) = –33,593/T + 7.00 (2540 to 2820°K). Since it is belived there are fewer uncertainties in the lower temperature region, the free energy of formation was derived from it: $\Delta F_f^0(UC_{1.99}) = 51{,}400 + 6.02T$. The calculated entropy of $UC_{1.99}$ is then 47 e.u. with an estimated error of ±2 e.u. When this value is compared with that calculable from the Debye theory, it is found to agree more closely with the value expected for a diatomic rather than for a triatomic substance. Since neutron diffraction studies have shown that uranium dicarbide contains C_2 units, the diatomic carbon may behave as a single unit in the thermal vibrations of the lattice. (auth)

25394 THE REACTION OF GRAPHITE WITH NITROGEN AT ELEVATED TEMPERATURES. J. Berkowitz (Argonne National Lab., Ill.). Preprint SM-26/40. 18p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The composition of the vapor at equilibrium when nitrogen reacts with graphite at a temperature of 2500°K was studied by a variation of the Knudsen effusion method. Nitrogen gas is introduced into a Knudsen cell lined with graphite, and the cell is heated by electron bombardment to a temperature in the range 2200 to 2500°K. The vapor effusing from the cell is collimated into a molecular beam and ionized by a transverse electron beam. The positive ions formed are accelerated and analyzed in a mass spectrometer. Several methods are used to distinguish the significant ion peaks from those due to residual background gas. At a nitrogen pressure of ca. 10^{-4} atm and a temperature in the range 2200 to 2500°K, the most abundant ions are N_2^+, CN^+ and those due to the vapor species above graphite, i.e., C^+, C_2^+, and C_3^+. Much smaller intensities of ions were observed that could conceivably be C_2N^+, C_3N^+, $C_2N_2^+$, $C_3N_2^+$, $C_3N_3^+$, $C_4N_2^+$, $C_4N_3^+$, and $C_6N_2^+$. The intensity of CN^+ was more than ten times greater than any of the latter ion peaks, and hence attention was focused on the reaction product which was the precursor of CN^+, namely the CN radical. A careful study of the concentrations of the various species in the equilibrium C (g) + ½ N_2 (g) ⇌ CN (g) was undertaken, in order to evaluate the equilibrium

constant. This datum, when combined with well-established thermodynamic and molecular properties, was used to compute the enthalpy change of this reaction, and hence the heat of formation of the CN radical. This value, ΔH_f (CN) = 109.5 kcal/mole, was compared with the results of a variety of previous experiments, including electron impact appearance potential measurements, spectroscopic observations, and detonation wave studies. The electron impact experiments, which favored ca. 90 kcal/mole for ΔH_f (CN), were re-interpreted to bring these results into reasonable agreement with those from the detonation wave experiments and from the present study. (auth)

25395 THERMODYNAMIC PROPERTIES OF ZrH_2, ZrD_2, YH_2 and YD_2. Howard E. Flotow and Darrell W. Osborne (Argonne National Lab., Ill.). Preprint SM-26/41. 29p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

ZrH_x and YH_x, where x can vary from near zero to a maximum of 2, can be conveniently prepared at 400°C by the direct reaction of the metal with hydrogen at one atmosphere pressure. For YH_x, compositions up to x = 3 can be made if the temperature is reduced to about 100°C. Both ZrH_2 and YH_2 are metallic-type compounds which are stable in air at room temperature, but they oxidize at an appreciable rate at 200°C or above. The equilibrium hydrogen pressures as a function of temperature and composition for these systems are briefly reviewed. The heat capacities of ZrH_2, ZrD_2, YH_2, and YD_2 were measured in an adiabatic type calorimeter from 5 to 350°K. At 298.15°K the heat capacity, C, the entropy, S^0, the enthalpy, $H^0 - H_0^0$ and the Gibbs free energy function $(F^0 - H_0^0)/T$, were evaluated. These quantities for ZrH_2 are 7.396 ± 0.015 cal deg^{-1} $mole^{-1}$, 8.374 ± 0.02 cal deg^{-1} $mole^{-1}$, 1284.1 ± 2 cal $mole^{-1}$, and −4.067 ± 0.01 cal deg^{-1} $mole^{-1}$, respectively; for ZrD_2 they are 9.631 ± 0.019, 9.168 ± 0.02, 1474.4 ± 3, and −4.223 ± 0.01, respectively; for YH_2 they are 8.243 ± 0.016, 9.175 ± 0.018, 1403 ± 3, and −4.470 ± 0.009, respectively; and for YD_2 they are 10.773 ± 0.022, 10.294 ± 0.021, 1659 ± 3, and −4.729 ± 0.010, respectively. The heats of combustion of ZrH_2 and ZrD_2 at 298.15°K were recently measured and these data together with the free energies of formation of ZrH_2 and ZrD_2 are compared with previously published results. The thermodynamic data presented can be used in conjunction with high temperature thermal measurements to obtain accurate thermodynamic functions for these hydrides above 350°K; the experimental data necessary, but not now available, to extend the temperature range are delineated. (auth)

25396 THE APPLICATION OF OXYGEN- AND FLUORINE-BOMB CALORIMETRY TO NUCLEAR MATERIALS. H. M. Feder, D. R. Fredrickson, E. Greenberg, W. N. Hubbard, R. L. Nuttal, E. Rudzitis, J. L. Settle, and S. S. Wise (Argonne National Lab., Ill.). Preprint SM-26/42. 10p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Oxygen-bomb and fluorine-bomb calorimetric techniques were applied to the determination of the standard heats of formation of a variety of materials of nuclear interest. The varied problems led to the development of new or special techniques. These include the use of: (a) a glass trial bomb for the observation of burning characteristics; (b) a suspension technique for sample support; (c) a plastic (mylar) envelope for the protection of air-sensitive materials; (d) a solvent in a rotating bomb to direct the course of reaction; and (e) a fluorine gas reservoir within a calorimeter for substances that burn spontaneously in fluorine. (auth)

25397 THERMODYNAMICS OF THE BINARY SYSTEMS OF URANIUM WITH Zn, Cd, Ga, In, Tl, Sn, AND Pb. I. Johnson and H. M. Feder (Argonne National Lab., Ill.). Preprint SM-26/43. 10p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

By means of galvanic cells with molten salt electrolytes U/UCl_3 + LiCl − KCl (eutectic)/U−M (alloy) where M is one of the B-subgroup metals, Zn, Cd, Ga, In, Tl, Sn or Pb, thermodynamic properties of the binary systems were obtained. The solubility of uranium in Ga, In, Tl, and Pb was redetermined as part of the experimental program. Partial molar relative enthalpies and excess entropies of uranium in the saturated liquid solutions are given, along with the standard heats and entropies of formation of the intermetallic compounds. All values were evaluated at 450°C with reference to α-uranium and liquid M. The heats and (Gibbs) free energies of formation of the intermetallic compounds (per gram-atom of compound) are found to become less negative as one progresses downward or to the left in the Periodic Table. These observations, together with available data on neighboring elements, are discussed in relation to the nature and strength of the bonding in intermetallic compounds. (auth)

25398 THERMODYNAMIC PROPERTIES OF COMPOUNDS OF ACTINIDE ELEMENTS. R. J. Ackermann and R. J. Thorn (Argonne National Lab., Ill.). Preprint SM-26/44. 37p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The thermodynamic properties of compounds of the actinide elements are correlated with those of the other elements by means of principles of chemical bonding describable by molecular orbital theory. The procedure used enables one to define precisely a chemical group, to explain the duality in chemical behavior of transactinium elements as both 5f and 5d elements, thereby clarifying what is meant by the actinide hypothesis, and removing much of the confusion concerning actinide, thoride, uranide etc. groups. Heretofore the subject of the thermodynamic properties was discussed from the point of view of ions in aqueous solution and solids (see discussions by Cunningham and by Haissinsky), but such cannot yet clearly reveal the basic and fundamental relations involved, because the environments and pertinent electronic configurations are unknown. An approach which has not yet been exploited is to make a correlative study involving the thermodynamics and high temperature chemistry of simple gaseous compounds. In particular reactions of the type, MO(g) = M(g) + O(g), and $MO_2(g)$ + 2O(g), at low pressures are ideal, because the atoms and molecules are in a field-free region and a common reference state is known, i.e., the neutral atoms and their associated electronic configurations. When the derived generalizations are incorporated into the molecular orbital theory, one is able to correlate the atomic orbitals with the behavior found by White, Walsh, Goldstein, and Dever with the dissociation energies of the monoxides of the rare earth elements. This agreement confirms the generalizations and enables one to predict the trends expected in the monoxides and dioxides of the actinide elements, and by recognizing the three-fold nature of these elements to explain the extent to which they are members of the respective a-subgroups, to which they

are similar to the rare earths, and to which they are "actinides." These same factors which determine the relative stabilities of the gaseous monoxides and dioxides also determine the stabilities of the metals and solid oxides, but in a more complex and subtle manner which can be understood only after the gaseous compounds are explained. These complexities are discussed by reference to a modified Born-Harber cycle which shows how each of the quantities, $\Delta H_f^0(MO_x,s)$, $\Delta H_v^0(M,c)$, $\Delta H_f^0(MO_x,s)$, and $D_c(MO_y,g)$, enter into the trends observed in the vaporization of oxides. (auth)

25399 VAPORIZATION AND THERMODYNAMIC PROPERTIES OF URANIUM SULFIDE AND OXYSULFIDE. E. David Cater, E. G. Rauh, and R. J. Thorn (Argonne National Lab., Ill.). Preprint SM-26/45. 20p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The investigations of the vaporization and thermodynamic properties of uranium monosulfide and of a mixture of uranium monosulfide and dioxide are discussed and analyzed for the purpose of obtaining consistent and reliable free energies and entropies of formation of gaseous US, UO, and UOS and solid US. The experiment with the mixture is particularly interesting in that it illustrates how one can resolve a moderately complex system of condensed-gas phase equilibria by the effusion method provided accurate thermodynamic data are available. Solid uranium monosulfide vaporizes to comparable amounts of gaseous US and gaseous U and S. By measurement of absolute rates of effusion (with the α-active isotopes, U^{235} and U^{234}) and of the ratio of gaseous uranium to monosulfide (with the aid of a mass spectrometer) it is possible to derive the properties of the two simultaneous equilibria US(s) = U(g) + S(g) and US(s) = US(g). The total effective pressure (calculated as if it were all US) is given by the empirical equation, $\log p_e$ (atm) = $-1.7382 + 3.1274 \times 10^4/T - 1.3181 \times 10^8/T^2 + 0.09378 \times 10^{12}/T^3$. Using the mass spectrometric data, one can separate the contributions of the uranium and the monosulfide to the effective pressure and find that $\Delta F_f^0(USs) = 64.0T - 268{,}000$ (cal/mole) and $\Delta F_f^0(USg) = 38.8T - 152{,}000$ (cal/mole). The measurements of the absolute effusion rates are sufficiently precise to derive the curvature in the free energies for the two reactions given above, but the precision of the free energy equations is limited by the mass-spectrometric method. The absolute entropies of solid and gaseous monosulfide are 45.1 and 83.4 eu, respectively. The solid is metallic and has a melting point of 2735°K. Mass spectrometric observations of the effusate from a cell containing a mixture of monosulfide and dioxide yield the relative partial pressures for the equilibrium US(g) + UO_2(g) = UO(g) + UOS(g), and from the variation of the equilibrium constant with temperature, one calculates the heat of this reaction. From measurement of the absolute rate of effusion and the known free energies of formation for gaseous monosulfide, dioxide, and monoxide one can calculate the free energy of formation and the dissociation energy of the oxysulfide. The relative bonding in the molecules US, UO, UOS, and UO_2 are discussed with an attempt to derive the bonding in the molecule US_2. (auth)

25400 VAPORIZATION PROPERTIES OF THORIUM, URANIUM, AND PLUTONIUM METALS AND OXIDES. R. J. Ackermann and R. J. Thorn (Argonne National Lab., Ill.). Preprint SM-26/47. 29p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The vaporization studies of the metals and oxides of thorium, uranium, and plutonium are critically analyzed in order to derive reliable free energies of formation of the the gaseous elements and oxides and to emphasize their role and importance in the thermochemistry of nuclear technology. As shown by Rauh and Thorn, a pressure of oxygen as small as 10^{-6} mm Hg suppresses the vapor pressure of uranium by a factor of three. Overlooking this fact, De Maria et al. recently attempted to measure the vapor pressure of uranium by observing mass spectrometrically the partial pressure of uranium in equilibrium with a mixture of liquid metal and aluminum oxide. It can be shown that these measurements actually yield the partial pressure of uranium over the two-phase region consisting of uranium dioxide and uranium at an activity reduced by the saturated solution of oxygen. Hence, contrary to recently published statements, the measurements by Rauh and Thorn are free of systematic errors and consequently yield a reliable value for the free energy: $\Delta F_f^0(U) = 106{,}760 - 26.09T$. Darnell et al. have demonstrated that traces of oxygen enhances the volatility of thorium. The difference between the two metals in this respect is one of kind involving the relative temperature dependence of solubilities of oxygen and the stabilities of the gaseous monoxides. For thorium $\Delta F_f^0(Th) = 131{,}700 - 27.41T$. Plutonium was less completely studied, but it is surmised that the effect is less. For plutonium $\Delta F_f^0(Pu) = 80{,}500 - 22.94T$. The free energies of all the known gaseous oxides of uranium were measured from studies by De Maria et al., by Ackermann et al., and by Ackermann et al. One writes that $\Delta F_f^0(UO) = -21{,}600 - 5.46T$, $\Delta F_f^0(UO_2) = -125{,}400 + 6.22T$, $\Delta F_f^0(UO_3) = -198{,}500 + 19.0T$. Uranium dioxide is unique in that it is the only oxide which reacts insignificantly with tantalum. Both ThO_2 and PuO_2 exhibit severe reaction at high temperatures to produce volatile tantalum oxides. The importance of the gaseous trioxide in transport of uranium in fuel elements fabricated of oxides is discussed. The apparent vapor pressure (in terms of gaseous dioxide) of thoria is given by the equation, $\log p$ (atm) = $-34{,}890/T + 7.98$. It is known that the vapor contains both monoxide and dioxide, the latter being predominant. Darnell and McCollum have studied the equilibrium, Th(l) + ThO_2(s) = 2ThO(g), from which the free energy of formation and dissociation energy of gaseous monoxide can be derived. Phipps et al. have studied the vaporization of plutonium dioxide, but the extent of reduction by the tantalum effusion cell is unknown. A more complete study of the data is effected. (auth)

25401 HIGH TEMPERATURE HEAT CONTENTS OF FIFTEEN REFRACTORY BORIDES. R. Mezaki, E. W Tilleux, D. W. Barnes, and J. L. Margrave (Univ. of Wisconsin, Madison). Preprint SM-26/48. 27p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

High precision thermodynamic properties for fifteen refractory borides (BN(hexagonal), BN(cubic), TiB_2, ZrB_2, HfB_2, NbB_2, TaB, TaB_2, CrB, CrB_2, Mo_2B, MoB, MoB_2, W_2B, WB, and W_2B_5) were determined with a copper-block drop-type calorimeter over the range 400 to 1200°K. Gold containers were used in all the experiments to minimize side reactions. From a consideration of available low temperature measurements and a new technique for fitting the high temperature data with Debye functions, it was possible to estimate S_{298}^0 for these substances with a reliability of ±1 entropy unit. (auth)

25402 THE EMBRITTLEMENT OF NIOBIUM IN HYDROGEN CONTAMINATED NaK. A. Thorley and C. Tyzack (Reactor Materials Lab., Culcheth, Eng.). Preprint SM-26/49. 34p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A study was made of the uptake and equilibrium levels of hydrogen attained by niobium specimens exposed to dynamic 70% sodium–30% potassium alloy circulated in an electromagnetically pumped circuit at 350°C. Hydrogen was added to the loop from a cold trap dispensing sodium hydride. In practice the value of concentration of hydride in the sodium was fixed by cold trapping at a particular temperature. A series of values of the corresponding pressure $p_{K(T)}$ in NaK at 350°C corresponding to cold trap temperatures of 100, 110, 120, 150, and 200°C was determined by equilibration of niobium specimens. These were subsequently analyzed for hydrogen content and the values obtained enabled calculations of the corresponding hydrogen equilibrium pressure to be made from extrapolations of the composition-pressure-temperature data of Komjathy. These values gave a measure of $p_{K(T)}$ at 350°C for various cold trapping temperatures and allowed the free energy iso-composition lines for unsaturated solutions of hydride in NaK as a function of temperature to be computed. These were plotted on an Ellingham-Richardson type of diagram, and in conjunction with the data of Komjathy on the niobium-hydrogen system enable estimates of the extent of hydrogen pickup by niobium exposed in hydrogen bearing NaK at various temperatures and under various cold trapping conditions to be made. The extent of the embrittlement of niobium at various hydrogen levels was also evaluated by mechanical tests. (auth)

25403 DETERMINATION OF THE RATE OF VAPORIZATION OF METALLIC OXIDES ON SAMPLES HEATED BY ELECTRIC CURRENT. N. M. Voronov, A. S. Danilin, and I. T. Kovalev. Preprint SM-26/53. 21p. (In Russian)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A method was devised for determining the rate of vaporization of metallic oxides on samples heated by an electric current. With this method, the rate of vaporization of uranium dioxide under vacuum conditions was determined, and its vapor tension was calculated for the temperature range 1450 to 2300°C. In addition, the rate of vaporization of thorium dioxide and zirconium dioxide in air was determined at temperatures from 1500 to 2000°C. (auth)

25404 MODERN THERMOCHEMICAL METHODS FOR DETERMINING HEATS OF FORMATION. H. Skinner (Univ. of Manchester, Eng.). Preprint SM-26/55. 18p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Developments made in the past two decades in the techniques of calorimetry and thermochemistry have provided means of measuring the heats of formation of a large variety of compounds which hitherto had received only inadequate thermochemical study. The important developments include: (a) rotating-bomb calorimetry, (b) fluorine-bomb and fluorine flame-calorimetry, (c) high temperature reaction calorimetry, and (d) calorimeters for the study of very slow reactions. The scope and potentiality of each of the techniques is discussed, with special reference to the measurement of the heats of formation of various nuclear materials. (auth)

25405 THE VAPOUR PRESSURE OF METALLIC YTTRIUM. A. N. Nesmeyanova, Y. A. Prisolkova, and V. V. Karelina. Preprint SM-26/56. 7p. (In Russian)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

A saturated vapor of 99.9% metallic yttrium was obtained through sublimation in a vacuum and the vapor pressure was measured. Oxygen and tantalum accounted for the 0.1% impurities. The measurements were made using an integral variant of the Knudsen diffusion method on a continuous operation apparatus, without interruption of the vacuum or heating conditions. The quantity of condensate was determined colorimetrically or radiometrically from the activity of the Y^{90} introduced into the specimen. The diffusion opening chosen was such as to produce saturation in the Knudsen chamber. The results of measurements in the temperature range 1361 to 1761°K are expressed by the straight line equation: $\log P \text{ (mm Hg)} = 7.8130 - 15803/T$. The heat of vaporization in the given temperature range is therefore equal to 72.31 kcal/g-atom, and when calculated for 298°K, it is equal, on the basis of the ϕ potentials, to 85.71 kcal/g-atom. (auth)

25406 THERMODYNAMIC PROPERTIES OF ZIRCONIUM AND ITS ALLOYS WITH TIN. G. B. Fedorov and E. A. Smirnov. Preprint SM-26/57. 26p. (In Russian)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The vapor pressure of zirconium and the partial vapor pressure of zirconium alloyed with tin was measured with specially designed apparatus, Knudsen's effusion method, and the radioisotope Zr^{95}. The equation devised for computing the saturated vapor pressure of pure zirconium is of the form $\lg p = 1.58 - 1.28 \times 10^4 (1/T)$. On the basis of the data obtained on vapor pressure of zirconium, some thermodynamic characteristics of β–zirconium (heat of sublimation, enthalpy, and entropy), and the thermodynamic activity and modification of the partial thermodynamic functions of zirconium alloyed with tin, were calculated. Changes in the heat of sublimation of zirconium in zirconium–tin alloys are indicative of an increase in the interatomic binding forces in zirconium. This is also demonstrated by the negative deviation from Raoult's law of the values of the thermodynamic activity of zirconium in its alloys with tin. (auth)

25407 CATALYTIC RECOMBINATION OF RADIOLYTIC GASES IN THORIUM OXIDE SLURRIES. L. E. Morse (to U. S. Atomic Energy Commission). U. S. Patent 3,048,474. Aug. 7, 1962.

A method for the combination of hydrogen and oxygen in aqueous thorium oxide-uranium oxide slurries is described. A small amount of molybdenum oxide catalyst is provided in the slurry. This catalyst is applicable to the recombination of hydrogen and/or deuterium and oxygen produced by irradiation of the slurries in nuclear reactors. (AEC)

Radiation Chemistry and Radiochemistry

Refer also to abstract 26480.

25408 (BM-RI-6022) HYDROGENATION OF IRRADIATED COAL. Paul S. Lewis, Walter Kawa, and Raymond

W. Hiteshue (Bureau of Mines. Pittsburgh Coal Research Center). Nov. 1961. 15p.

Lignite and high-volatility A and C and low-volatility bituminous coals were exposed to 1 billion roentgens of gamma radiation; specimens of A and C bituminous from other sources received 6 million roentgens of x radiation. Irradiated and unirradiated control specimens were hydrogenated in autoclave experiments at 6000 psi final pressure and 400°C with retention times of 15, 30, or 60 min depending on the coal rank and catalytic treatment. Comparison of results from irradiated specimens with those from the control experiments showed that irradiation had no beneficial effect on the coal. High-volatility C bituminous coal may have been affected by radiation more than the other coals. One billion roentgens appeared to reduce the amount of coal converted to liquids and gases by about 10%, and 6 million reduced it by about 6% when catalyzed with tin. In all other cases, the conversion of irradiated coal was either reduced by as much as 4% or was essentially the same as that obtained with unirradiated coal. (P.C.H.)

25409 (BNL-740) POLYMERIZATION OF ETHYLENE BY COBALT-60 GAMMA RADIATION. Radiation Processing Report No. 4. Meyer Steinberg, P. Colombo, R. N. Chapman, and George Adler (Brookhaven National Lab., Upton, N. Y.). July 1962. Contract [AT(30-2)-GEN-16]. 43p.

The yield and rate of ethylene polymerization was determined under conditions of pressure, from 680 to less than 68 atm, temperature, from −78 to 40°C, and intensity, from 20000 to 560000 rad/hr. Polymerization took place in the liquid phase at −78°C at a very low rate. In the gas phase at 20 to 40°C a strong inhibition and retardation effect due to oxygen impurity was noted, and the induction period as oxygen concentration varied was determined. The effect of the presence of polymer on the polymerization rate is smaller than the effect of oxygen and ethylene pressure. The addition of argon acts as a diluent in decreasing the polymerization rate. The differential G values based on monomer alone, were determined, and attempts were made at expressing these values as a function of ethylene pressure and radiation intensity. At 133000 rad/hr a maximum differential G value of 15000 was obtained. At 21000 rad/hr a maximum value of 47000 was reached. These correspond to polymerization rates of 21.5 and 14.2 g/l/hr, respectively. Additions of solid substrates of alumina and molecular sieves increase the G value by a factor of 2.2 to 2.5, and the rate by a factor of 1.6 to 1.9, indicating a surface effect. The polymers produced consisted of fine white powder with properties dependent on pressure and irradiation conditions. (P.C.H.)

25410 (CEA-2120) CONTRIBUTION A L'ETUDE D'UNE METHODE DE MESURE CONTINUE DE L'EFFET ISOTOPIQUE. RECHERCHE D'UNE EFFET ISOTOPIQUE DANS LA REDUCTION DE L'OXYDE CUIVREUX PAR LE MELANGE $^{12}CO-^{14}CO$ (theses). (Contribution to the Study of a Method for Measuring Continuously the Isotopic Effect. The Search for an Isotopic Effect During the Reduction of Cuprous Oxide by a $^{12}CO-^{14}CO$ Mixture (thesis)). Jacques Richard (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 120p.

Submitted to Univ. of Lyon.

The determination of an isotopic effect between $C^{12}O + Cu_2O \rightarrow C^{12}O_2 + 2$ Cu light reaction and $C^{12}O + Cu_2O \rightarrow C^{14}O_2 + 2$ Cu heavy reaction is possible if the respective kinetics are known. The condensation, during the reaction, of the carbon dioxide formed, and the measurement as a function of time of the residual carbon monoxide pressure, makes it possible to deduce the light reaction kinetics. The heavy reaction kinetics are obtained by measuring continuously, in situ, the radioactivity of the residual reactant gas as a function of the time. A calibration curve of the measured radioactivity as a function of the reactant gas pressure in the absence of reaction makes it possible to compare the kinetics of the light and heavy reactions. The reaction temperature is chosen such that the reaction rate is sufficiently slow, so that the variation of the radioactivity during unit counting time is negligible. (auth)

25411 (JINR-P-978) IZUCHINIE PRODUKTOV REAKTSII TYAZHELYKH ELEMENTOV S MNOGOZARYADNYMI IONAMI. I. RADIOKHIMICHESKOL RASPREDELENIE Ac^{225} AND Ac^{226}, VOZNIKAYUSHCHIKH PRI OBLUCHENII URANA I TORIYA IONAMI. (Products of Heavy Element Reactions with Multicharged Ions. I. Radiochemical Determination of Ac^{225} and Ac^{226} Produced in U and Th Bombardment by Nitrogen and Neon). I. Brandstetr, M. Krzhivanek, Ya. Maly, and Su Hung-kui (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 13p.

Ac^{225} and Ac^{226} were produced from the bombardment of Th^{232} and U^{238} by nitrogen or neon ions. It is supposed that these isotopes were produced due to the stripping of a number (6−13) of nucleons from the nucleus of the bombarded element. The cross sections for actinium isotopes are higher in the thorium bombardment (stripping of 6−7 nucleons) than in the uranium bombardment (stripping of 12−13 nucleons). It is necessary to account for the daughter products of actinium as a possible source of the back ground in identifying the transuranium elements. (auth)

25412 (NAA-SR-6734) HYDROGEN FORMATION IN THE RADIOLYSIS OF TOLUENE. R. B. Ingalls (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). July 30, 1962. Contract AT(11-1)-GEN-8. 18p.

The evolution of hydrogen ($H_2 + HD + D_2$) from the radiolysis of liquid toluene, toluene-α,α,α-d_3, toluene-d_8, and equimolar solutions of pairs of the toluene analogs was studied. Results indicate that a disproportionately large fraction of the hydrogen gas evolved during radiolysis is from the hydrogen atoms of the methyl group, that a fraction of the gas is formed by an intramolecular process, and that some of the gas is formed by a bimolecular process other than abstraction from the methyl group. An interpretation based on free radical reactions is presented which accounts qualitatively for the data presented. (auth)

25413 (NP-11882) RESEARCH ON SOLID STATE RADIATION-INDUCED PHENOMENA. Quarterly Progress Report No. 9, February−April 1962. Hartmut P. Kallmann (New York Univ., New York). May 1962. Contract DA 36-039 SC-85126. 36p.

The semiconductivity produced by self-activation in cadmium sulfide zinc crystals was investigated. It can be ascribed to the formation of Frenkel and Schottky defects. A cooling technique is described which enables the temperature of a cooled sample to be kept constant within $^1/_{10}$ degree. The sample is dipped into a dewar vessel which has a pipe coming out at the level where the liquid nitrogen should be maintained. Closing the dewar top provides an automatic self-control of the liquid level when liquid nitrogen is pumped into the vessel via a syphon pipe. Measurements of a-c impedance were used to determine the photoconductivity of a ZnS:Cu phosphor. To obtain homogeneous excitation, long wavelength irradiation (blue and green light) was used. The results indicate that even with this type of excitation (activator absorption only) some inhomogeneity exists. The γ-ray induced fluorescence of a series of de-

oxygenated solution of p-terphenyl in o-xylene was measured as a function of increasing temperature. Quenching was greatest in the absence of solute. Dilution of the solvent by a non-transferring liquid did not affect the degree of quenching. (auth)

25414 (NYO-10184) EVALUATION OF BETA RADIATION AS A HYDROGENATION CATALYST. Quarterly Technical Status Report No. 1, March 1, 1962–May 31, 1962. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). July 1, 1962. Contract AT(30-1)-2978. 30p.

Construction of a high temperature, high pressure bench scale processing unit for the evaluation of beta radiation catalysis of hydrogenation-cracking of coal derivatives to liquid fuels was completed. The 100 to 400 curie Strontium-90 internal source of radiation for inside the reactor is being fabricated. A program is given for the initial study of the radio-catalysis including a series of base reference runs with coal extract and several model compounds. (auth)

25415 (ORNL-3309) SOLUBLE NEUTRON POISONS AS A PRIMARY CRITICALITY CONTROL IN SHIELDED AND CONTAINED RADIOCHEMICAL FACILITIES. J. P. Nichols (Oak Ridge National Lab., Tenn.). July 26, 1962. Contract W-7405-eng-26. 43p.

Studies indicated that the use of soluble poisons as a primary criticality control offers economic and other advantages in that it permits the factors of vessel size and shape and solution concentrations to be dictated by considerations other than those of criticality. It is believed that soluble poison criticality control can be made as reliable as other methods of conditional control if the application is preceded by adequate development work and is monitored by multiple, independent safeguards. The studies included multigroup machine calculations of the required content of poisons in solutions of fissile and fertile material, a compilation of data on the detection, stability, decontamination, and costs of soluble poisons, and an assessment of the possible effects of a nuclear excursion. (auth)

25416 (PAN-289/ChR) THE EFFECT OF NAPHTHALENE CONCENTRATION ON RADIATION YIELD OF THE HYDROGEN IN DEAERATED "NEDA" SOLUTIONS. Stefan Minc, Wacław Stachowicz, and Zbigniew Kecki (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1961. 7p.

$G(H_2)$ values from the radiolysis of deaerated naphthalene in NEDA solutions (high boiling fraction of petroleum) were determined. Protective action of naphthalene was found. Density and viscosity measurements of the solutions were done. (auth)

25417 (PAN-302/V) HOT ATOM CHEMISTRY OF β-DECAY. II. BOND FORMATION BETWEEN RADIOIODINE ATOMS AND TOLUENE. Aleksander Halpern (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 15p.

The bond formation between toluene and I^{131} or I^{132}, formed in the decay of $Te^{131}Cl_4$ or $Te^{132}Cl_4$, was investigated. The total organic yield was higher in the case of I^{132}, although its recoil was lower than that of I^{131}. It was concluded that the reactivity of radioiodine atoms activated in β, γ decay depends on excitation and ionization, rather than on kinetic energy. The percentage yields of some organic products, as well as the effect of small concentration of elemental iodine and allyl iodide were also studied. The hypothesis is advanced that atoms activated in β, γ decay participate in epithermal reactions, and that formation of an excited intermediate complex occurs as an initial stage of the reaction. (auth)

25418 (RAI-308) A STUDY OF THE MECHANISM OF RADIATION-INDUCED GELATION IN MONOMER-POLYMER MIXTURES. Summary Report, May 1, 1961–April 30, 1962. George Odian and Bruce S. Bernstein (Radiation Applications Inc., Long Island City, N. Y.). June 13, 1962. Contract AT(30-1)-2816. 53p.

The effects of polyfunctional monomers on the efficiency of the radioinduced cross linking of polyethylene were studied. The efficiency of any particular monomer was found to be dependent on the extent to which it swells the polymer and on its chemical structure. The dose required to produce a 50% gel content in polyethylene was found to be approximately 1.5 Mrads for the monomer cross linking technique using allyl methacrylate as compared to 11 Mrads for the straight radiation technique. The applicability of this method was also studied for polypropylene. The dose required for incipient gelation under straight radiation cross linking conditions was found to be approximately 50 Mrads. Using allyl methacrylate, 70% gel was obtained after approximately 2 Mrads. Preliminary results showed that the use of polyfunctional monomers can change the direction of radiation effects on polyisobutylene. It was found that the use of 14% allyl acrylate yields a gel content of approximately 55% after 1 Mrad of radiation. Monomer-free polyisobutylene, not only does not give a gel at this dosage, but in addition, is actually degraded to lower molecular weight material. It was also found that the monomer cross linking technique is useful in increasing the efficiency of the radiation cross linking of polystyrene. (M.C.G.)

25419 (RRL-84) QUARTERLY REPORT [ON RADIATION RESEARCH], APRIL 1, 1962–JUNE 30, 1962. (Mellon Inst. Radiation Research Lab., Pittsburgh). July 10, 1962. Contract AT(30-1)-2310. 15p.

Brief summaries of progress on investigations on ESR studies of transient hydrocarbon radicals, chemical reactions of I^{128} recoil atoms, production of methyl radicals in hydrogenous materials, yield of H in neutral aqueous solutions, radiolysis of deaerated aqueous isopropanol solutions, photolysis of CCl_4 in presence of ethylene, photosensitized reactions in solution, gas phase photolysis of ethyl iodide at 1849 Å, and molecular processes in gas phase radiolysis of ethyl chloride are given. (P.C.H.)

25420 (SRIA-62) RADIATION STABILITY OF ORGANIC LIQUIDS. Semi-Annual Report No. 3, December 21, 1961 to June 30, 1962. A. H. Samuel and W. E. Wilson (Stanford Research Inst., Menlo Park, Calif.). June 30, 1962. For Oak Ridge National Lab., Tenn. Contract AT(04-3)-115. 12p.

Three methods for the analysis of dibutyl hydrogen phosphate (DBP) and monobutyl dihydrogen phosphate (MBP) in irradiated systems of tributyl phosphate (TBP), Amsco, uranyl nitrate, nitric acid, and water were investigated. An extraction method based on the greater acidity of DBP and MBP as compared to other acid radiolytic products seemed promising at first. However, it was shown that recovery of the two esters was not quantitative. Considerable effort was devoted to an attempt to analyze for DBP and MBP by means of gas-liquid partition chromatography. The parameters, which were varied, include column material and length, temperature, solvent, and gas flow rate. No reproducible positive results were obtained. Separation of TBP, DBP, and MBP by paper chromatography was achieved with good results and the foundation laid for the use of TBP labeled with phosphorus (P^{32}) in a new series of irradiations. (auth)

25421 (WADD-TR-61-38) RADIATION CHEMISTRY OF PENTANE ISOMERS. Roger E. Rondeau and Dennis R. Johnson (Aeronautical Systems Div. Physics Lab., Wright-Patterson AFB, Ohio). Mar. 3, 1961. 21p. (AD-270876)

Three isomeric pentane gases were exposed to Co^{60} gamma rays, and the hundred electron volt yields of the lower molecular weight products were determined. The isomers studied were normal, iso-, and neopentane. The products formed from each isomer were: hydrogen, methane, acetylene, ethane, propene, propane, butenes, and butanes. Some of the radiolysis products are explained on the basis of free radical reactions and mechanisms. (auth)

25422 (AEC-tr-4576) RADIOCHEMISTRY. Translation of Radiokhimiya, 2: Nos. 1-2, (1960). 287p. (PST-Cat.-565-566).

25423 (AEC-tr-4577) RADIOCHEMISTRY. Translation of Radiokhimiya, 2: Nos. 3-4, (1960). 257p. (PST-Cat.-567-568).

25424 (AERE-Trans-894) RADIATION-INDUCED OXIDATION OF HYDROCARBONS. S. Ciborowski. Translated by W. Bourke (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England) from Wiadomości Chem., 15: 225-46(1961). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20768.

25425 γ-RADIATION-INDUCED POLYMERIZATION OF p-N, N-DIMETHYLAMINOSTYRENE. P. Jager and E. S. Waight (Imperial Coll., London). J. Polymer Sci., 59: 847-8(June 1962).

Samples of p-N, N-dimethylaminostyrene were irradiated for different lengths of time and at different temperatures at a constant dose rate of 0.10 Mrad/hr. Results indicated that the conversion rate has a maximum value in the temperature region just below the melting point and was considerably higher than the values obtained by Chapiro for the solid-state polymerization of styrene. (M.C.G.)

25426 IMPROVED DIELECTRICS PRODUCED BY MEANS OF HIGH-ENERGY RADIATION. F. B. Waddington (Associated Electrical Industries Ltd., Manchester, Eng.). AEI (Assoc. Elec. Ind.) Eng., 1: 154-8(Apr. 1961).

An outline is given of production of solid dielectrics by radiation polymerization, and of specialized techniques such as encapsulation of components by radiation polymerization and adhesion by graft polymerization. The modification of dielectrics is summarized, with attention to such examples as the radiation cross-linking of elastomers to give form-stable rubber-like resilient materials that are insoluble and infusible, and the modification of thermoplastic polymers to yield insoluble and infusible products. The radiation scission of molecules to produce polymeric foams is also noted, as is the controlled decomposition of some polymers in order to control their physical properties. (T.F.H.)

25427 SEPARATION OF ISOTOPICALLY SUBSTITUTED HYDROCARBONS BY PARTITION CHROMATOGRAPHY. THERMODYNAMIC PROPERTIES AS CALCULATED FROM RETENTION VOLUMES. W. E. Falconer and R. J. Cvetanović (National Research Council, Ottawa). Anal. Chem., 34: 1064-6(Aug. 1962).

A number of hydrocarbons were effectively separated from their partially and fully deuterated isomers on a 300-foot nonpolar capillary column. Relative retentions are reduced by 0.7_2% at 25°C, 0.6_1% at 50°C, 0.5_2% at 80°C, and 0.4_9% at 105°C, per substituent deuterium atom. Boiling points were determined for a number of deutero species by the chromatographic method. From the relative retention volumes at several temperatures, differences in the enthalpy, entropy, and free energy of solution for several partially and fully deuterated isomers were calculated, and the values are reported. In view of the small differences in these quantities from the values of the corresponding light isomers, the chromatographic method is particularly suitable for such determinations, as they would be difficult to make accurately by standard techniques. (auth)

25428 USE OF AN IONIZATION CHAMBER FOR MEASURING RADIOACTIVITY IN GAS CHROMATOGRAPHY. EFFLUENTS. James Winkelman and Arthur Karmen (National Heart Inst., Bethesda, Md.). Anal. Chem., 34: 1067-71(Aug. 1962).

Highly sensitive measurement of radioactivity in the effluent of a gas chromatography column was performed using an ionization chamber. The organic materials leaving the chromatography column were first subjected to combustion over heated copper oxide. The carbon dioxide produced was then conducted to an ionization chamber for carbon-14 assay. The water produced was either trapped or was reacted with heated iron to release hydrogen gas for tritium assay. The ionization chamber used for the measurement was 275 cc in volume, permitting highly efficient assay. An additional gas flow was supplied to the chamber to reduce its response time. The sensitivity of the method was such that 202 micromicrocuries of carbon-14 or 227 micromicrocuries of tritium in a compound emerging 8 minutes after injection could be distinguished from baseline fluctuations. The sensitivity of the ion chamber to unlabeled compounds, which limited its applicability to measurements at this order of sensitivity, was eliminated by including the water trap in the system. (auth)

25429 LIQUID SCINTILLATION COUNTING OF TRITIUM. IMPROVEMENTS IN SENSITIVITY BY EFFICIENT LIGHT COLLECTION. Royal H. Benson and Robert L. Maute (Monsanto Chemical Co., Texas City, Tex.). Anal. Chem., 34: 1122-4(Aug. 1962).

The use of light guides to improve routine tritium counting efficiency was investigated. By optimizing the tritium spectrum with respect to the discriminators and using an effective light guide, a differential tritium counting efficiency of 44% can be obtained for routine use. Counting errors arising from varying sample volumes and condensation on the vial are eliminated by use of the light guide. (auth)

25430 THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF A NUMBER OF RHODIUM COMPOUNDS. L. I. Barsova, A. K. Pikaev, Vikt. I. Spitsyn, and A. A. Balandin (Moscow Univ.). Doklady Akad. Nauk S.S.S.R., 144: 344-6(May 11, 1962). (In Russian)

Aqueous solutions 0.001 to 0.03M in $RhCl_3$, $Rh(NO_3)_3$, $Rh_2(SO_4)_3$, $Rh(ClO_4)_3$ and $[Rh(NH_3)_5 Cl] Cl_2$ were given a dose of 2 to 6.0×10^{21} ev/ml with 0.8 Mev electrons. The formation of rhodium black with catalytic properties was noted only on irradiating the $[Rh(NH_3)_5 Cl] Cl_2$ solution at a pH > 12.5. The optical density at 360 mμ first increased sharply with dose. With further irradiation the optical density decreased, and rhodium black precipitated from solution. The G yield (atoms of Rh per 100 ev) was 0.16. The precipitation of rhodium black was accompanied by a decrease in the pH of the solution due to oxidation of NH_3 by OH radicals and due to the decomposition of H_2O_2. (TTT)

25431 THE FORMATION OF AN ORIENTED STRUCTURE DURING THE RADIATION POLYMERIZATION OF A VINYL MONOMER ON A FIBER. A. V. Vlasov, P. Ya. Glazunov, N. V. Mikhailov, S. R. Rafikov, L. G. Tokareva,

B. L. Tsetlin, and M. V. Shablygin (Inst. of Metal Organic Compounds and All-Union Research Inst. of Artificial Fibers, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 382-3(May 11, 1962). (In Russian)

An attempt was made to grow an oriented synthetic polymer by exposing a gaseous monomer (acrylonitrile) to a "matrix" of a caproic acid-amide fiber in the presence of radiation. The x-ray dose strength was 3×10^{15} ev/cm^3-sec, and the time of irradiation was 3 to 6 hours. The temperature of the matrix fiber was 80°C during irradiation, and the temperature of the monomer was 40°C (vapor pressure of 200 mm Hg std). The increase in weight of the fiber was 15 to 33 wt.% after polymerization of the monomer. Infrared spectroscopy in polarized light showed up a perpendicular dichroism on the fiber. The magnitude of the dichroism (0.83 to 0.87) indicated a definite orientation. No dichroism, and consequently no orientation, could be detected, when the acrylonitrile monomer was polymerized on a non-orientated caproic fiber, or on an oriented fiber wetted with liquid monomer. The data indicate that polymerization of a monomer from the gaseous phase onto an orientated fiber in a high-level radiation field results in the directed growth of a new orientated polymer. (TTT).

25432 THE CHEMICAL BEHAVIOR OF FLUORINE 18 PRODUCED BY THE $O^{16}(H^3,n)$ NUCLEAR REACTION. M. Anbar and P. Neta (Weizmann Inst. of Science and Israel Atomic Energy Commission, Rehovoth). J. Am. Chem. Soc., 84: 2673-8(July 20, 1962).

F^{18} atoms produced by the $Li^6(n,\alpha)H^3$, $O^{16}(H^3,n)F^{18}$ nuclear reactions were found to substitute hydrogen on organic molecules. The extent of labeling of a given organic molecule was found to be proportional to the number of hydrogens per molecule. In solid lithium salts, irradiated by slow neutrons, the yield of organically bound F^{18} was 0.6 to 1.0% per aliphatic hydrogen, as compared to 0.3 to 0.6% per aromatic hydrogen. Compounds were also labeled in solutions and the yield was dependent on the concentration of the solute. The yield of labeling of aliphatic solutes was higher than that of aromatic. The addition of aromatic compounds to an aliphatic solvent diminished the labeling yield of the solvent, however no appreciable labeling of the aromatic solute was observed. Aliphatic solutes, on the other hand, did not affect the yield of labeling of aliphatic solvents. Formic acid and nitrite ions were found to diminish considerably the yield of labeling in aqueous or alcoholic solutions. The results suggest that the active chemical species in the fluorine labeling reactions are non-excited fluorine atoms. Interactions with electron donors are of primary importance in the behavior of fluorine atoms in organic media. (auth)

25433 ELECTRON SPIN RESONANCE AND ISOTOPIC EXCHANGE STUDIES IN THE TRITIUM–POLYSTYRENE FLUFF SYSTEM. J. Y. Yang, R. B. Ingalls, and J. R. Hardy (Atomics International, Canoga Park, Calif.). J. Am. Chem. Soc., 84: 2831-2(July 20, 1962).

The use of finely divided polystyrene fluff as the reaction medium for studies of reactions induced by the β radiation of tritium gas is reported. The electron spin resonance spectrum in the tritium–polystyrene fluff system was essentially identical with that observed in gamma-irradiated polystyrene. The degree of tritium labeling in uncrosslinked polystyrene was determined by dissolving the reacted fluff in benzene and then subjecting the benzene solutions to liquid scintillation counting. (M.C.G.)

25434 GAS-PHASE RADIOLYSIS OF PROPANE. P. Ausloos and S. Lias (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 36: 3163-70(June 15, 1962).

The radiolysis of $CH_3CD_2CH_3$ and of equimolar C_3H_8–C_3D_8 mixtures in the presence of radical scavengers was investigated as a function of pressure from 0.35 to 6000 mm and as a function of temperature from 40 to 220°C. In the presence of scavengers, hydrogen and methane are mainly produced by molecular elimination. Values for the ratio CH_2D/CH_4 were found to increase with pressure and with surface to volume ratio of the irradiation vessel. Ethane is mostly formed by a hydrogen transfer reaction such as $C_2H_7^+ + C_3H_8 \rightarrow C_2H_6 + C_3H_7^+$. From the distribution of the isotopic ethanes formed in the radiolysis of $CH_3CD_2CH_3$, it can be concluded that the hydrogen atoms in the $CH_3CD_2^+$ ion undergo a rapid randomization prior to reaction with propane. Ethylene can be accounted for by the occurrence of the following processes: decomposition: $C_3H_7^+ \rightarrow CH_4 + C_2H_4$, ion molecule reactions, and decomposition of vibrationally excited propyl and/or ethyl radicals. From a comparison of the radiolysis results with the mass spectral cracking pattern of propane and recent photochemical studies, it can be deduced that the decomposition of propane ion and of neutral excited propane molecules are responsible for the products. The relative importance of these two modes of decomposition depends on the pressure and the size of the reaction vessel. (auth)

25435 PHOTO-IONIZATION OF ALKYL FREE RADICALS. Fred A. Elder, Clayton Giese, Bruce Steiner, and Mark Inghram (Univ. of Chicago). J. Chem. Phys., 36: 3292-6(June 15, 1962).

Studies of the photo-ionization of the methyl, ethyl, propyl, and isopropyl radicals are reported. The radicals were prepared by pyrolysis of the appropriate alkyl nitrites, tetra-alkyllead compounds, and the dialkylmercury compounds. Secondary processes occurring in the energy range covered (7.2 to 11.7 ev) are discussed. The appearance potentials for the methyl, ethyl, propyl, and isopropyl radicals, as measured by photo-ionization-mass spectrometric techniques are 9.82 ± 0.04, ≤ 8.4, ≤ 8.1, and ≤ 7.5 ev, respectively. The adiabatic transition is accessible for the methyl radical only. Hence, the ionization potential of the ethyl, propyl, and isopropyl radicals cannot be determined by ordinary photon or electron impact experiments. (auth)

25436 RADIATIONLESS TRANSITIONS AND RADIATIVE LIFETIME OF $^3B_{1u}$ STATE OF BENZENE. E. C. Lim (Loyola Univ., Chicago). J. Chem. Phys., 36: 3497-8 (June 15, 1962).

Redeterminations were made of the absolute fluorescence and phosphorescence quantum yields of benzene in EPA at 77°K were made by the use of the integrating-sphere technique. The results yielded 0.20 ± 0.02 for both emissions. Use of these quantum yields together with the observed phosphorescence lifetime of 7.0 sec in the expression $T_N = T_0 (1 - \varphi_F)/\varphi_P$ gives for the value of the radiative lifetime, T_N, 28 ± 4 sec. A 26 sec lifetime was obtained by Robinson et al. The possible existence of a significant $S_1 \rightarrow S_0$ (lowest excited singlet to ground singlet) radiationless transition in benzene was studied. (M.C.G.)

25437 VACUUM PHOTOLYSIS OF SOLID ETHANE AT 77°K. Milton D. Scheer, James McNesby, and Ralph Klein (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 36: 3504-5(June 15, 1962).

Photolysis of solid ethane at 77°K was carried out using a krypton resonance lamp containing a LiF window as the source of 1236 A radiation. The solid was irradiated for 20 min and the volatile products were collected. The hydrogen and methane were analyzed by mass spectrometry. Photolysis of condensed ethane was found to occur with a quantum yield of the same order of magnitude as that for the gas phase. The high quantum yields in the solid strongly

suggested that the dissociative lifetime of the excited ethane molecule is comparable to or less than the period of a lattice vibration, 10^{-13} sec. It was concluded that the predominant primary process in the solid ethane photolysis is an intramolecular H_2 detachment. (M.C.G.)

25438 BETA ENERGY RECOIL EFFECTS OF CARBON-14 IN TOLUENE AND ETHYLBENZENE. P. G. Manning and C. B. Monk (University Coll. of Wales, Aberystwyth). J. Chem. Soc. 2573-6(July 1962).

Recoil energy from C^{14} beta particles in [Me-C^{14}] toluene was found to cause negligible bond rupture, as judged by the yield of aniline, while with [α-C^{14}] ethylbenzene about 15 to 20% bond rupture occurred. This was in line with a concept of rupture being caused by electronic excitation. (auth)

25439 RADIATION CHEMISTRY OF CARBOHYDRATES. PART IX. THE ACTION OF γ-RADIATION ON DEAERATED D-MANNOSE SOLUTIONS. G. O. Phillips and W. J. Criddle (University Coll., Cathays Park, Cardiff). J. Chem. Soc. 2733-9(July 1962).

Gamma irradiation of D-mannose solutions in vacuo gives D-mannonic acid, D-glucosone, 2-oxogluconic acid, D-arabinose, D-erythrose, two- and three-carbon aldehydic fragments, oxalic acid, and polymeric material. By use of radioactive tracer and paper-chromatographic methods, the products were estimated at several doses. By reference to the yield-dose curves the following primary processes were identified: oxidation at C-1 to give mannonic acid, attack at C-2 to give glucosone, scission between C-3 and C-4 to give three-carbon aldehydic fragments, and scission between C-2 and C-3 to give erythrose and a two-carbon aldehydic fragment with simultaneous, direct conversion of the hexose molecule into three two-carbon aldehydic fragments. D-Arabinose, 2-oxogluconic acid, and smaller fragments are formed by secondary processes. Initial processes account for an initial $-G$(D-mannose) of 2.4; the experimentally determined value is 3.5. It is suggested that the primary processes unaccounted for relate to the dimerization of primary radicals formed as a preliminary step in the formation of polymer. The results indicate that, although initial radicals formed from D-mannose in oxygen and in vacuo are similar, their subsequent fate is different in the absence and in the presence of oxygen, thereby giving rise to different final products. (auth)

25440 RADIATION CHEMISTRY OF CARBOHYDRATES. PART X. ACTION OF γ-RADIATION OF AQUEOUS D-RIBOSE SOLUTIONS IN OXYGEN. G. O. Phillips and W. J. Criddle (University Coll., Cathays Park, Cardiff). J. Chem. Soc. 2740-4(July 1962).

D-Ribose was degraded by γ irradiation in dilute aqueous solution with initial $-G$ of 3.2 to 3.3. Primary degradation processes, identified by reference to yield-dose curves, led to the formation of D-ribonic acid, three- and two-carbon aldehydic fragments, and a further unidentified acid. D-Erythrose arose, in the main, from secondary processes. Thus, the main effects of radiation which were identified are end-group oxidation and chain scission to give two- and three-carbon aldehydic fragments. (auth)

25441 REACTION OF NEUTRON ACTIVATED ARSENIC ATOMS IN ORGANIC MEDIA. [PART] II. $AsPh_3$–BENZENE SYSTEM. K. E. Siekierska and A. Sokolowska (Inst. of Nuclear Research, Warsaw). J. Inorg. & Nuclear Chem., 24: 13-22(Jan. 1962). (In English)

The quantitative distribution of the active products following the neutron irradiation of solutions of arsenic triphenyl and arsenic trichloride in benzene was investigated. The scavenging action of dissolved oxygen was explored and the results interpreted in terms of the different kinds of reaction in which the radioactive fragments can participate. Comparative measurements on the behavior of a solution of diphenyl arsine oxide were also made. A new method of paper chromatographic separation of the products was used. (auth)

25442 RADIOCHEMICAL STUDIES OF ISOTOPES OF ANTIMONY AND TIN IN THE MASS REGION 127-130. E. Hageboe, A. Kjelberg, and A. C. Pappas (Univ. of Oslo and Gustaf Werner Inst. for Nuclear Chemistry, Uppsala). J. Inorg. & Nuclear Chem., 24: 117-31(Feb. 1962). (In English)

Rapid radiochemical methods based on isopropyl ether-hydrochloric acid extraction for separation of antimony from enriched tellurium targets, and on ethyl ether-ammonium thiocyanate extraction for separation of tin from fission product mixture were developed. Antimony daughters were periodically milked from tin by stripping of the ether phase with ammonium thiocyanate. The nuclides reported are: 9.9 ± 0.5 min Sb^{129m}, 9.9 ± 0.5 hr Sb^{129g}, 7.1 ± 0.4 min Sb^{130m}, 33 ± 2 min Sb^{130g}, 4.6 ± 0.4 min and 2.2 ± 0.2 hr Sn^{127}, 57 ± 4 min Sn^{128}, and 8.8 ± 0.6 min and 1.0 ± 0.1 hr Sn^{129}. Assignment of isomeric states in Sn^{127} and Sn^{129} cannot be made with present evidence. (auth)

25443 THE CHEMICAL STATE OF CHLORINE-36 IN NEUTRON-IRRADIATED MINERALS. C. W. Owens and F. S. Rowland (Univ. of Kansas, Lawrence). J. Inorg. & Nuclear Chem., 24: 133-7(Feb. 1962). (In English)

The oxidation state assumed upon solution by Cl^{36} formed by thermal neutron irradiation of chlorine-containing minerals was determined. Except for about 0.2 and 0.9 per cent as ClO_3^- in carnallite and chlorapatite, respectively, all the Cl^{36} radioactivity was found in the chloride state. The Cl^{36} radioactivity in the chloride state in carnallite and chlorapatite was reduced by thermal annealing. (auth)

25444 THERMAL ANNEALING OF NEUTRON-IRRADIATED CHLORINE OXYANIONS. M. Vlatković and A. H. W. Aten, Jr. (Inst. for Nuclear Physics Research, Amsterdam). J. Inorg. & Nuclear Chem., 24: 139-46(Feb. 1962). (In English)

Thermal annealing of the products of the Szilard-Chalmers process in neutron irradiated alkali chlorates is similar to annealing in most salts containing oxyanions. In perchlorates and sodium chlorite an inverse type of annealing is observed, which means that the percentage of the activity in the chlorate + chlorite + hypochlorite fraction decreases on heating. (auth)

25445 PREPARATION OF HIGH SPECIFIC ACTIVITY $TERBIUM^{161}$ FROM GADOLINIUM. K. S. Bhatki (Atomic Energy Establishment, Trombay, India), K. P. Gopinathan, and A. T. Rane. J. Inorg. & Nuclear Chem., 24: 215-17 (Feb. 1962). (In English)

A method for purifying terbium-161 in carrier-free form using Dowex-50 resin at room temperature is described. The method indicates a critical pH of the semi-molar lactate solution for separating terbium-161 from gadolinium-153. Solutions having a pH less than 3.53 give well-separated elution curves when the time factor becomes important because of the short half-life of the isotope. About 100 to 150 mg of gadolinium oxide was used in this method which required irradiation of one week in the Apsara Reactor at Trombay, India, at 10^{12} n cm^{-2} sec^{-1}. (N.W.R.)

25446 RADIATION-INDUCED CROSSLINKING OF POLYPOTASSIUM ACRYLATE. R. N. Bashaw and B. G. Harper (Dow Chemical Co., Freeport, Tex.). J. Polymer Sci., 59: 221-31(June 1962).

The effects of radiation on potassium acrylate and polypotassium acrylate and their aqueous solutions were studied. In the presence of air and at high and low water concentrations, degradation is the predominant radioinduced reaction. Crosslinking occurs at intermediate concentrations. The degree of crosslinking for a given dose reaches a maximum at a polymer concentration of about 60%. An explanation of these results is presented. (auth)

25447 ACTION OF RADIOCOBALT GAMMA RAYS ON AQUEOUS SOLUTIONS ON POLYOXYETHYLENEGLYCOL. C. Crouzet, and J. Marchal (Centre pour Les Recherches sur Macromolecules, Strasbourg). J. Polymer Sci., 59: 317-20(June 1962). (In French)

The irradiation of aqueous solutions of polyoxyethylene glycol by radiocobalt γ rays was investigated. Results demonstrated the existence of two opposite mechanisms, the one leading to crosslinking of the polymer and the other to degradation. (auth)

25448 STUDY OF RADIOACTIVE CONTAMINATIONS OF ISOTOPE P-32 PREPARATIONS BY MEANS OF A HUMIC PREPARATION. Mária Szilágyi. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 3: 3-9(Apr. 1961). (In Hungarian)

Preparations of P^{32} were studied in three tests independent from one another. The preparations were presignified as containing negligible amounts of contamination Zn^{65}, Fe^{55}, and Sb^{124}. After adsorption and elution tests on the humus-column, the active contaminating substances were γ spectrometrically identified one by one in the eluate-fraction. In the isotope preparations, Sb^{124} was found to be in an anion form, while one of the preparations also contained Co^{60} in addition to the predicted contaminating substances. (auth)

25449 THE MECHANISM OF THE CHEMICAL SECONDARY REACTIONS AFTER (n,γ) NUCLEAR TRANSFORMATIONS IN SOLIDS AND THE RANGE OF THE RECOIL ATOMS. Horst Mueller (Universität, Anorganische Abteilung, Freiburg i B.). Naturwissenschaften, 49: 182 (1962). (In German)

A fraction of the recoil atoms produced in thermal neutron capture in solids reacts within the solid to form the initial substance again (retention). Thus the nuclear process $Re^{185}(n,\gamma)Re^{186}$ leads in K_2ReBr_6 to 28.5% $Re^{186}O_4^-$ and two 71.5% $Re^{186}Br_6^{2-}$. Three mechanisms for the origin of retention are discussed. In studies with a homogeneous mixed crystal $K_2ReBr_6 - K_2SnCl_6$, it was determined that the principal part of the retention occurs by the mechanism in which so much heat is generated in the slowing down of the recoil atom that a small lattice area was "melted" so that reactions could occur which led back to the original substance. It was calculated that the reaction zone had a radius of 5.4 Å. (J.S.R.)

25450 RADIATION EFFECTS IN BRAZILIAN PEPPERMINT OIL. P. G. Garratt, H. Fazackerley, P. R. Hills, and R. Roberts (Wantage Research Lab., Berks, Eng.). Perfumery Essent. Oil Record, 52: 4p. (Aug. 1961).

An investigation was made of effects of radiation on peppermint oil. An attempt was made to discover some correlation between olfactory and chemical changes. The physical properties of Brazilian peppermint oil were virtually unchanged by radiation. Two chemical effects of radiation were observed. Peroxides were produced with a G value of 26, and camphene disappeared with a G value of 1.5. No radiolytic products were detected. (M.C.G.)

25451 RADIATION-INDUCED OPTICAL ABSORPTION IN KNO_3 CRYSTALS. Joseph Cunningham (Argonne National Lab., Ill.). Phys. and Chem. Solids, 23: 843-62(July 1962). (In English)

The optical density of KNO_3 crystal was increased from 240 through 1000 mμ by exposure to x or γ-irradiation at 77 or 4.2°K. The increase is accounted for by the growth of seven radioinduced absorption bands, termed, I, II, III, IV, V, VI, and VII. The response of the individual bands to selective optical bleaching was determined. Light which reduced optical absorption bands was also observed to selectively reduce signals in the electron paramagnetic resonance (EPR) spectra of similarly-irradiated KNO_3 crystals. These EPR signals were previously assigned to specific nitrogen–oxygen radicals. A tentative identification of bands I and V with NO_2^{2-}, band VI with NO_3, band VII with NO_2, and band III with NO_3^{2-}, was made on the basis of correlations between the EPR and optical response. The known extinction coefficients of NO_2^-, NO_2 etc., together with their measured concentrations, were also considered in making this identification scheme. The response of the optical bands to the selective optical bleaching is accounted for on this scheme by electron release from NO_2^{2-} and capture by NO_3 and NO_2, hole release from NO_2, and photolysis of NO_3^{2-} by 325 mμ light. Molecular orbital descriptions of the species are discussed to deduce approximate positions, E_{max}, and oscillator strengths, f, of transitions in the proposed species. The deduced values of E_{max} are in qualitative agreement with the observed positions of maximum absorbance at 510, 355, 325, 290, 270, 246, and 410 mμ for bands I to VII, respectively. (auth)

25452 DISCUSSION OF SOME MECHANISMS OF F-CENTRE FORMATION IN ALKALI HALIDES. J. H. O. Varley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. and Chem. Solids, 23: 985-1005(July 1962). (AERE-R-3842). (In English)

Some mechanisms of the formation of F-centers in alkali halide crystals by x-irradiation are discussed with particular reference to the multiple ionization mechanism. A model is presented for calculating the x-ray energy absorbed per F-center formed and reasonable agreement with low temperature experimental values is obtained. Room temperature behavior of x-irradiated alkali halides is also considered in some detail and reasonable agreement with experiment is again obtained using simple models to calculate the volume dilatation and rate of F-center formation in typical cases. (auth)

25453 LATTICE COMPRESSIBILITY AND ITS RELATION TO THE RADIOLYSIS OF IONIC NITRATES AT 700 ATMOSPHERES. Joseph Cunningham (Argonne National Lab., Ill. and Illinois Inst. of Tech., Chicago) and Lawrence R. Steele. Phys. Rev. Letters. 9: 47-9(July 15, 1962).

Changes in the rates of radiolysis of solids when the lattices are under compression were studied. Gamma irradiation was performed on $NaNO_3$, KNO_3, $RbNO_3$, and $CsNO_3$ at 163 to 288°K to 700 atm. Decomposition rates were measured and compared with calculations. Radiolysis rate decreases greater than those predicted from cage-volume considerations only were found. (L.N.N.)

25454 COMPLETENESS OF BOND RUPTURE IN THERMAL NEUTRON CAPTURE OF GASEOUS TRIMETHYL PHOSPHINE. M. Halmann (Brookhaven National Lab., Upton, N. Y.). Proc. Chem. Soc., 289-90(Aug. 1960). (BNL-[illegible])

In a study of the radiative neutron capture reaction $P^{31}(n,\gamma)P^{32}$, gaseous trimethylphosphine (Me_3P) was irradiated in the BRR. The yield of parent activity was found to decrease with reduced initial pressure of trimethylphosphine. Experiments with pure argon as moderator were conducted to show that true retention of the bond structure

of recoiling P^{32} in Me_3P does not occur to an appreciable extent, but that the reduction of parent activity yield can be attributed to complete bond breakage of the recoiling P^{32}. (J.R.D.)

25455 CROSSLINKING OF POLYETHYLENE AND PARAFFINS BY ULTRA-VIOLET RADIATION IN THE PRESENCE OF SENSITIZERS. A. Charlesby, C. S. Grace, and F. B. Pilkington (Royal Military Coll. of Science, Shrivenham, Berks, Eng.). Proc. Roy. Soc. (London), A268: 205-21(July 10, 1962).

Paraffins and polyethylene can be crosslinked by exposure to ultraviolet radiation in the presence of sensitizers. Measurements were made of quantum efficiency, sensitizer concentration, and degree of crosslinking, and compared with previous results for specimens exposed to γ or electron radiation. It is found that crosslinking and degradation both occur with ultraviolet radiation in approximately the same ratio as for γ radiation, thereby indicating that the same radical process is involved. The number of crosslinks is directly related to the number of sensitizer molecules destroyed, whereas only a fraction of the ultraviolet quanta absorbed result in any change in the sensitizer. Thus the over-all reaction occurs in two distinct stages: absorption of ultraviolet radiation by sensitizer, with a small probability of radical formation in the latter; and reaction between sensitizer radical and polymer molecule, this process being highly efficient. Once the radical was formed on the sensitizer, the reaction proceeded in a manner almost parallel to that for γ irradiation. There is no evidence of a distinctive reaction due to the ionization produced with the latter, high-energy, form of radiation. The influence of oxygen, molecular weight, and physical state of paraffin on the reaction were also investigated and the fate of the sensitizer determined. This technique offers an interesting possibility of studying some of the effects of ionizing radiation, by introducing an intermediate step which can be determined independently and quantitatively. Discrepancies between the effects of ultraviolet and γ radiation would appear if ions play an important role in the reaction. (auth)

25456 EFFECTS OF γ-RAYS ON THE FERROELECTRIC PARAMETERS OF CRYSTALS OF GUANIDINIUM ALUMINUM SULFATE. V. A. Yurin, A. S. Baberkin, and I. S. Zheludev (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 7: No. 1, 121-3(July-Aug. 1962). (In English)

The effects of γ rays on guanidinium aluminum sulfate (GAS), $C(NH_2)_3\,Al(SO_4)_2 \cdot 6H_2O$, were studied with special attention given to the possibility of producing a stable monodomain state. The ordinary hysteresis loop gradually became double if the specimen was irradiated unpolarized. A steady electric field exceeding the saturation field caused the loop to become unipolar after the crystal had received a certain dose in the monodomain state. The stability of either the polydomain or monodomain state was proportional to the gamma dose. Crystals of GAS remained colorless after irradiation. (M.C.G.)

25457 STUDIES ON THE MECHANISM OF RADIATION POLYMERIZATION. I. MECHANISM OF THE GAMMA-RAY INDUCED POLYMERIZATION OF ISOBUTENE AND STYRENE. A. P. Sheinker and A. D. Abkin. Vysokomolekulyarnye Soedineniya, 3: 716-23(1961).

The gamma-ray induced polymerization and copolymerization of styrene and isobutene in ethylchloride were investigated at -78 and 0° and monomer concentration of 2.5 mole/l. The polymerization rate of styrene at $-78°$ was 20.1×10^{-6} and of isobutene 14.1×10^{-6} mole/l. sec. The copolymerization rate at $-78°$ for all initial mixture compositions was less than the individual polymerization rate. Isobutylene does not polymerize at 0° and there is a different relation between the copolymerization rate and the initial mixture composition. The isobutylene-styrene copolymer was found to be enriched in the isobutylene component; r_1 (isobutylene) = 3.5; r_2 = 0.33. The molecular weight of the polystyrene was 70,000, of the polyisobutylene 80,000 and of the copolymers, depending upon the composition, 27,000-55,000 (from light scattering data). The rate of polymerization of polystyrene and isobutylene is proportional to the dose energy and the first degree of monomer concentration. The data on the copolymer composition and the kinetic relations afford convincing evidence that gamma-ray induced low temperature polymerization of isobutene and styrene is brought about by carbonium chains. (tr-auth)

25458 STUDIES IN THE MECHANISM OF RADIATION POLYMERIZATION. II. MECHANISM OF THE CARBONIUM POLYMERIZATION OF STYRENE AND METHYL METHACRYLATE INITIATED BY GAMMA RAYS. M. K. Yakovleva, A. P. Sheinker, and A. D. Abkin. Vysokomolekulyarnye Soedineniya, 3: 828-32(1961).

The gamma-ray induced copolymerization of styrene and methyl methacrylate in ethyl chloride solution was studied at monomer concentration 2.0 mole/l. and temperatures ranging from +25 to $-78°$. The dose rate was 110 rad/sec. The relative amount of the styrene component of the copolymer increased with lowering of the temperature from +25 to $-78°$. The styrene-methyl methacrylate copolymers are sharply enriched in styrene at $-78°$ for all monomer mixtures; r_1 (styrene) = 20; r_2 = 0.005. A sharp inhibition of styrene polymerization is observed when small amounts (ca. 0.1 mole) of methyl methacrylate are added to the former. In radical polymerization, styrene retards polymerization of methyl methacrylate. Data on the copolymer composition and kinetic data lead to the conclusion that copolymerization of styrene and methyl methacrylate at low temperatures initiated by gamma rays proceeds by means of a carbonium mechanism. (tr-auth)

25459 CATALYTIC AND RADIATION POLYMERIZATION AND COPOLYMERIZATION OF ALLYLHYDROSILANES. I. N. Lyashenko, N. S. Nametkin, L. S. Polak, A. V. Topchiev, A. S. Feldman, and T. I. Chernysheva. Vysokomolekulyarnye Soedineniya, 3: 833-40(1961).

The catalytic and radiation polymerization of allylsilanes containing the Si–H bond were investigated. Benzoyl peroxide and platinized carbon were used as catalysts; irradiation was carried out with γ and β rays. Monoallylsilanes polymerize to viscous liquids. The products of the polymerization of diallylsilanes are powders. The principal relations of catalytic polymerization were shown to hold also for radiation polymerization. The radiation copolymerization of various allylsilane derivatives containing Si–H bonds with acrylonitrile and styrene was studied. It was shown that a small percentage of organosilicon compounds in copolymerization with styrene change the physical properties of polystyrene. An examination of the infrared spectra showed that the Si–H bond remained in all the resultant polymers and copolymers, the least amounts being preserved in the homopolymers. In the latter the double bond is also consumed. The ESR spectra of the polymers and copolymers were investigated. (tr-auth)

25460 FREE RADICAL REACTIONS IN IRRADIATED POLYTETRAFLUOROETHYLENE. III. RECOMBINATION OF ALKYLFLUORIDE AND PEROXIDE RADICALS. Yu. D. Tsvetkov, Ya. S. Lebedev, and V. V. Voevodskiĭ. Vysokomolekulyarnye Soedineniya, 3: 882-90(1961).

The kinetics and rate constants of recombination of peroxide and alkylfluoride radicals in irradiated teflon of various degrees of crystallinity were determined with the aid of the ESR method. The recombination was shown to be a second order reaction, the rates in the amorphous zones of the polymer differing from those in the crystalline zones. The degree of crystallinity of the specimens may be estimated from the linear anamorphoses of the kinetic curves. On the basis of the experimental and reported data on the rate constants, the recombination mechanism of radicals in polymers was discussed. The rate of recombination is apparently determined by the motion of the chain segments. The anomalously high values of the pre-exponential factors and the compensation effect in the recombination of alkyl radicals were interpreted in terms of a fall in the segment rotation barrier on approaching the melting temperature. (tr-auth)

25461 X-RAY INDUCED POLYMERIZATION OF ACETALDEHYDE IN THE CONDENSED PHASE. V. S. Pshezhetskii, V. A. Kargin, and N. A. Bakh. Vysokomolekulyarnye Soedineniya, 3: 925-30(1961).

The x-ray induced polymerization of acetaldehyde in the amorphous and crystalline phases was investigated. It was found that there is practically no reaction in the liquid and amorphous phases. The process increases in effectiveness with increase in the degree of crystallinity. The degree of conversion is lowered on the addition of small quantities of agents. The effect of the agents is independent of their chemical nature and is evidently due to impairment of the crystal lattice of the monomer. The polymerization rate increases with increasing temperature up to the melting point of the monomer. This may be the outcome of an increase in mobility of the molecules in the lattice. No post-effect was revealed. The findings give grounds for the assertion that polymerization of solid acetaldehyde proceeds not by a radical mechanism but is associated with charge or excitation energy transfer along the crystal lattice of the monomer. (tr-auth)

25462 SOME PROBLEMS OF THE RADIATION CHEMISTRY OF WATER. Jerzy Kroh (Katedra Chemii Fizycznej Politechniki, Lodz, Poland). Wiadomości Chem., 16: 135-43(Mar. 1962). (In Polish)

The mechanism of water radiolysis is briefly discussed; special attention is focused on the action of densely ionizing radiations, first of all Po^{210} α particles. (auth)

Raw Materials and Feed Materials

25463 (ACCO-12) ELUTION OF URANIUM FROM ANION EXCHANGE RESINS BY PREGNANT RAND SOLUTIONS. Topical Report. J. H. Pannell, S. B. Michal, D. F. Thorpe, G. W. Lower, and F. W. Bloecher, Jr. (American Cyanamid Co. Atomic Energy Div. Raw Materials Development Lab., Winchester, Mass.). Apr. 30, 1953. Contract AT(49-1)-533. 61p.

The causes for loss of uranium originally adsorbed on strong base anion exchange resins from Rand cyanide residue leach liquors after prolonged passage of such liquors through resin columns were investigated. These liquors contained low concentrations of polythionates which were more strongly held by the resin than uranium and could displace uranium from the resin. Other anions such as cobalticyanide and ferricyanide were also more strongly adsorbed than uranium but their presence in the liquor, although suspected, could not be demonstrated by analysis. Because of competition, polythionates decreased uranium loadings. Thiocyanate did not affect loading but decreased the rate of uranium elution. Polythionates were partially eluted during the normal uranium elution cycle and accumulated in the eluate on recycle. They could be destroyed by the addition of peroxide or chlorine to leach liquors or eluates. Although they appeared to be the agents primarily responsible for self-elution they did not appear to have a permanent poisoning effect on the resin. The polythionates were thought to be derived from oxidation during acid leaching of sulfur compounds produced during cyanidation. (auth)

25464 (ACCO-15) PROGRESS REPORT [ON PROCESSING URANIUM ORES], SEPTEMBER 16, 1951–NOVEMBER 15, 1951. (American Cyanamid Co. Atomic Energy Div., Watertown, Mass.). Contract AT(49-1)-533. 83p.

Elution tests of low grade Congo ores with NaCl solutions are described. Results of H_2SO_4 leaching tests on Radium Hill ores from S. Australia conducted under varying conditions and recovery of U from the liquor as U_3O_8 are reported. Filtration difficulties due to precipitation of titania were alleviated by flotation. Results of roasting previous to leaching are shown. Straight H_2SO_4 leaching of Temple Mountain ore was as efficient as a combination technique using Na_2CO_3 and H_2SO_4. Results of tests of Na_2CO_3 leaching of Rand residues are tabulated. Ion exchange studies on the effect of Co, thiocyanate, and polythionate in Rand liquors and resin life testing studies are described and the results of tests are given. Methods of applying ion exchange to the recovery of U from the Climax plant liquors are described and test results of the various steps, using 2-in. diameter columns, are shown. Lyometallurgical studies with the effect of organo-phosphates on the extraction of U from Chattanooga shales are described. (auth)

25465 (ACCO-26) PRELIMINARY STUDIES OF THE ABSORPTION OF URANIUM IN A RESIN-IN-PULP SYSTEM. Charles S. Abrams and David Kaufman (American Cyanamid Co. Atomic Energy Div. Raw Materials Development Lab., Winchester, Mass.). July 27, 1953. Contract AT(49-1)-533. 68p.

Data were obtained in nonflowing and flowing (continuous) batch adsorption systems to serve as a guide to the operating conditions that should be used in a resin-in-pulp adsorption system for the recovery of uranium from ores. Most of the work was done with artificial solutions rather than pulps. In nonflowing systems, studies were made to determine the effect of uranium loading and resin type on the time required to reach equilibrium. The effect of contact time, number of contacts and ratio of solution to resin on adsorption and elution was also determined. In flowing systems the effect of residence time, total cycle time, ratio of solution to resin, and number of cells on adsorption and elution was investigated. A complete cyclic test was conducted to demonstrate the applicability of the process. (auth)

25466 (ACCO-43) ION EXCHANGE TESTS ON LIQUOR AND PULPS PRODUCED FROM UTEX ORES. Topical Report. E. T. Hollis, Fred J. Pickwick, Jr., A. R. Kazanjian, H. I. Vicklund, J. B. Larson, F. A. Howland, and E. S. Porter (American Cyanamid Co. Atomic Energy Div. Raw Materials Development Lab., Winchester, Mass.). July 30, 1954. Contract AT(49-1)-533. 36p.

Uranium leach liquors produced from Utex ore by cold leaching, hot leaching, and pugging proved amenable to the ion exchange process. Higher resin loadings were obtained from the cold leach liquors than from the hot leach and pug liquors. In general, the less vigorous leaching conditions produced liquors which gave the highest resin loadings. In

addition, a resin-in-pulp system was operated using the lucite Winchester cells on Utex pulp produced by cold leaching. Satisfactory loadings were obtained. (auth)

25467 (ANL-6362) THE DISTILLATION OF URANIUM HEXAFLUORIDE AND BROMINE PENTAFLUORIDE IN A 0.5-INCH-DIAMETER PACKED COLUMN. Richard O. Ivins (Argonne National Lab., Ill.). May 1962. Contract W-31-109-eng-38. 97p.

The efficiency of a 0.5 in. dia packed column with $\frac{1}{16}$ in. nickel helices for the separation of the binary system UF_6-BrF_5 was investigated. Several distillations were performed with the system methylcyclohexane and n-heptane for purposes of calibration. For both systems, pressure-drop measurements at various flow rates were determined and the flooding rates were determined from these. Experiments to determine the equilibrium time were also conducted with both the organic and inorganic systems used for calibration. The separation efficiency was calculated as Htu_g. The flooding rates determined were 570 for methylcyclohexane, 2680 for uranium hexafluoride, and 2200 lb/(hr)(ft^2) for bromine pentafluoride. Equilibrium times of 34 and 24 hr were found for the organic and inorganic systems, respectively. The Htu_g was found to be 1.2 in. for flows of 50 to 450 lb/(hr)(ft^2) for the organic system. The Htu_g for the inorganic system was 1.3 in. at flow rates above 285 lb/(hr)(ft^2) and was found to increase to almost 3 in. at flow rates below this. (P.C.H.)

25468 (NCL/AE-197) DEVELOPMENT OF A ROTARY-FILM CONTACTOR FOR THE SOLVENT EXTRACTION OF METALS FROM SLURRIES. PART I. THE EXTRACTION OF URANIUM FROM ORES AND CONCENTRATES. A. A. North (Gt. Brit. National Chemical Lab., Teddington, Middx., England). Feb. 1961. 48p.

A description is presented concerning the development of a rotary-film contactor for the extraction of U from sulfuric acid-leached ore pulps and from concentrates by use of kerosene solutions of dialkyl phosphoric acid and tertiary alkylamines respectively. Excellent U recoveries were obtained. Scale-up rules were determined and theoretical considerations were examined. (J.R.D.)

25469 THE SYSTEM UF_6-NH_4F. B. Volavšek (Jožef Stefan Institut, Ljubljana, Jugoslavia). Croat. Chem. Acta, 33: 181-6(1961). (In German)

UF_6-gas (I) reacted with NH_4F-solid (II) to yield products with the ratio I : II varying from 1 : 1.60 to 1 : 4.46. On condensing I into a suspension of II in $C_2H_2Cl_4$ a stoichiometric composition of NH_4UF_7 (III) was repeatedly obtained. X-ray powder data of III indicate a cubic phase (a = 13.11 Å) different from both I and II. (auth)

25470 KHIMIYA I TEKHNOLOGIYA FTORISTYKH SOYEDINENII URANA. (Chemistry and Production of Uranium Fluoride Compounds). N. P. Galkin, A. A. Mairov, U. D. Veryatin, B. N. Sudarikov, N. S. Nikolaev, Yu. D. Shishkov, and A. B. Krutikov. Moscow, Gosatomizdat, 1961. 348p.

Production and physico-chemical properties of uranium tetrafluoride, hexafluoride, and other fluoride salts are described. Production processes, equipment, and automatic control in fluoride salt production are described. (R.V.J.)

25471 OSNOVNYYE PROTSESSY I APPARATY TEKHNOLOGII URANA. (Principal Processes and Equipment in Uranium Production). N. P. Galkin and V. B. Tikhomirov. Moscow, Gosatomizdat, 1961. 218p.

Uranium technology and equipment used for the recovery of uranium from ores are discussed. The principal U production processes (grinding, dehydration, leaching, ion exchange, hydrometallurgical extraction, crystallization, drying, and stirring) are described. (R.V.J.)

Separation Processes

Refer also to abstract 26489.

25472 (AERE-R-4039) THE AMP PROCESS FOR CAESIUM SEPARATION. III. RECOVERY OF CAESIUM FROM LOADED AMP COLUMNS BY SOLVENT EXTRACTION. J. van R. Smit and F. C. W. Pummery (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1962. 17p.

An investigation is described concerning a dipicrylamine-nitrobenzene extraction system and its use in the recovery of Cs from alkaline molybdate–phosphate solutions. The extraction system is highly selective for Cs, however because of the relatively low solubility of dipicrylamine in nitrobenzene, low concentrations of feed materials should be used. (J.R.D.)

25473 (CEA-2123) MANIPULATION DE L'HEXAFLUORURE DE PLUTONIUM. (The Handling of Plutonium Hexafluoride). Philippe Berard (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1962. 88p.

The problem of plutonium hexafluoride instability is discussed. The influence of various factors on the decomposition of the fluoride was studied: physical aspect of the walls, nature of the metal and its pretreatment, and influence of the temperature. A means of detecting plutonium-239 in a metallic apparatus by γ-ray counting was developed; the sensitivity is of the order of half a milligram, but the precision is very low (about 50%). Yields of over 95% were obtained for the transfer of plutonium during the preparation and sublimation of the hexafluoride. The possibility of using plutonium hexafluoride for the extraction of plutonium from irradiated fuel elements by a dry method was confirmed. (auth)

25474 (IS-470) REMOVAL OF PLUTONIUM FROM URANIUM BY MOLTEN METAL EXTRACTION. A. F. Voigt, R. G. Clark, J. G. Gonser, D. L. Haes, G. J. Lutz, and K. L. Malaby (Ames Lab., Ames, Iowa). May 1962. Contract W-7405-eng-82. 32p.

The extraction of plutonium from molten uranium with immiscible molten metals, silver, lanthanum, and cerium, was investigated. A facility is described in which experiments on uranium containing 0.2% plutonium were conducted safely. The distribution coefficients and efficiency of removal from uranium were determined for silver and lanthanum at several temperatures in the range 1175-1375°C and for cerium at 1225°C. In order to permit a statistical analysis of the results, 20-30 g of metal were used for each phase and, after cooling, the phases were sectioned and the sections analyzed individually. It was found that the extraction into silver was accompanied by slagging reactions which removed variable quantities of the plutonium and led to poor agreement among runs. Hence the distribution coefficient and its temperature dependence could not be determined with much accuracy. An average value of 14 ± 1 was obtained for the coefficient defined on a molar basis. The lanthanum and cerium extractions were much more reproducible. They extract much less of the plutonium, with a distribution coefficient of 0.4 for lanthanum and 0.5 for cerium. (auth)

25475 (NCL/AE-172) A PRELIMINARY REPORT ON THE SOLVENT EXTRACTION OF BERYLLIUM FROM

LOW GRADE SULPHATE AND FLUORIDE SOLUTIONS. A. A. Bueggs, J. V. Martin, G. L. Milward, and G. H. E. Sims (Gt. Brit. National Chemical Lab., Teddington, Middx., England). Dec. 1958. 19p.

Beryllium was extracted from sulfuric acid leach liquors using kerosene solutions of both di-(2-ethylhexyl) hydrogen phosphate and monododecyl dihydrogen phosphate. Ferric iron and aluminium were also extracted, the order of preference being Fe > Be > Al. Iron and aluminum once extracted are not readily displaced by beryllium. The stripping of all three metals from the phosphate esters was examined briefly. It was not found possible to extract beryllium from fluoberyllate solutions with the phosphate esters tested. Kerosene solutions of high molecular weight amines did not extract beryllium from fluoberyllate or from sulfate solutions to any useful extent under the conditions studied. (auth)

25476 (ORNL-2971(Vol.4)) BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL. VOLUME 4. HAZARDS AND PROTECTION 4.00. T. F. Connolly (Oak Ridge National Lab., Tenn.). Contract [W-7405-eng-26]. 246p.

Approximately 1434 references are given to books, bibliographies, symposia, journals, and contractors' topical reports. Most of the material dates from the 1955 Geneva Conference to the present. Required controls and standards which apply to various stages of fuel reprocessing are referenced. Shipping, dosimetry, insurance, and state and national regulations concerning them are referenced in detail. (P.C.H.)

25477 (ORNL-3273) SEPARATION OF TRANSPLUTONIUM ELEMENTS BY PHOSPHONATE EXTRACTION. R. D. Baybarz (Oak Ridge National Lab., Tenn.). Aug. 3, 1962. Contract W-7405-eng-26. 14p.

A process for separating transcurium elements from americium and curium, which consists of preferential solvent extraction of the transcurium elements with 2-ethylhexylphenylphosphonic acid from dilute HCl solutions, was developed and tested on a laboratory scale. Single-stage separation factors of 100 were found between californium and curium. Extraction positions of Am, Cm, Bk, Cf, Es, and Fm were determined. Extraction varied with the inverse third power of the acid composition in the range 1-4 N and directly with the third power of the extractant concentration. (auth)

25478 (ORNL-3296) A STUDY OF THE KINETICS OF URANYL SULFATE EXCHANGE WITH A STRONG BASE ANION RESIN (thesis). J. S. Watson (Oak Ridge National Lab., Tenn.). Aug. 1, 1962. Contract W-7405-eng-26. 95p.

A study of uranyl sulfate anion exchange rates with a strong base resin, Dowex 21K, indicated that essentially all of the uranium in the resin behaved as a single anion independent of individual species in solution. The rates at which uranyl sulfate loaded on sulfate- or chloride-equilibrated resin could be predicted reasonably accurately from the self-diffusion coefficients of the ions involved provided the uranium ion had a charge of 2− (e.g. $UO_2(SO_4)_2^{2-}$). The rate predicted by assuming the uranium had a charge of 4−(e.g. $UO_2(SO_4)_3^{4-}$) was notably higher than was observed experimentally. The rate at which chloride solutions eluted uranium from the resin also appeared to be governed by a single uranium species in the resin, but this is not the same ion involved in loading. The diffusing uranium ion is probably UO_2^{2+} both in the resin and solution phases during elution, but the self-diffusion coefficient of this ion in the resin is very difficult to determine. It is not possible to check this hypothesis and predict the elution rates without this coefficient. (auth)

25479 (ORNL-TM-288) POWER REACTOR FUEL REPROCESSING PILOT PLANT: ACCOUNTABILITY MEASUREMENTS PROGRAM. W. T. McDuffee (Oak Ridge National Lab., Tenn.). July 18, 1962. Contract [W-7405-eng-26]. 6p.

The accountability procedures to be followed in the Power Reactor Fuel Reprocessing Pilot Plant during the next few years are described and the limits of error given. (auth)

25480 (PAN-270/V) SINERGETICHESKIE I ANTAGONISTICHESKIE EFFEKTY V EKSTRAKTSII SOEDINENII PLUTONIYA. (The Synergetic and Antagonistic Effects on the Plutonium Extraction Systems). M. Taube (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1961. 20p.

The synergetic and antagonistic effects for plutonium(IV) and (VI) nitrate and sulfate liquid-liquid extraction were investigated for the following systems: monododecylphosphoric acid (DDPA) and tri-n-butylphosphate (TBP); thenoyltrifluoroacetone (TTA) and TBP; di-nibutylphosphoric acid (DBP) and TBP; tri-n-octylamine (TOA) and TBP; and TOA and DBP. The effects of the diluents (CCl_4, C_6H_6, and $CHCl_3$) and inorganic acids were also investigated. Some partial mechanisms for synergetic and antagonistic effects are discussed. (auth)

25481 (PAN-303/V) THE INFLUENCE OF DILUENT ON THE EXTRACTION OF IRON(III) FROM HYDROCHLORIC ACID SOLUTIONS BY TERTIARY AMINES. Wiktor Smułek and Sławomir Siekierski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 31p.

A study was made of the extraction of iron(III) from hydrochloric acid solutions with tertiary amines in a series of diluents. From the experimentally determined extraction coefficients of iron, k, and activities of the amines, a, the activity coefficients of the complex, y_c, were calculated. The effect of diluent on a, y_c, and k is discussed from the point of view of intermolecular interaction. (auth)

25482 (AEC-tr-5197) EXTRACTION OF URANIUM, PLUTONIUM, RUTHENIUM, AND ZIRCONIUM WITH TRI-ISO-OCTYLAMINE. Werner Knoch. Translated by L. L. Smith (Savannah River Lab., Aiken, S. C.) from Z. Naturforsch., 16a: 525-7(1961). 7p.

A correlation is made between partition coefficient, ligand concentration, and complex type in the solvent extraction of plutonium, ruthenium uranium, and zirconium using triisooctylamine. The correlations are valid for the distribution of the elements in tracer concentrations between an anion exchanger phase (resin) and the outer solution at equilibrium conditions. In a system in which anion complexes can be formed, the partition coefficient will first increase with increasing ligand concentration, pass through a maximum, and then decrease with increasing anion complex formation. (N.W.R.)

25483 SELECTIVE DISSOLUTION OF URANIUM IN URANIUM-URANIUM OXIDE MIXTURES. G. F. Brunzie, T. R. Johnson, and R. K. Steunenberg (Argonne National Lab., Ill.). Anal. Chem., 33: 1005-6(July 1961). (UAC-4745)

An 8 N solution of Br in ethyl acetate selectively dissolves U metal, leaving uranium oxides unattacked. Interfering acids produced by side reactions of Br with the solvent are neutralized by MgO, permitting the dissolution period to be extended. (auth)

25484 CATION EXCHANGE SEPARATION OF VANADIUM FROM METAL IONS. James S. Fritz and Janet E. Abbink (Ames Lab., Ames, Iowa). Anal. Chem., 34: 1080-2 (Aug. 1962). (IS-415)

Vanadium(IV) or (V) can be separated from other metal ions by elution from a cation exchange column with dilute acid containing 1% or less hydrogen peroxide. Vanadium is quantitatively removed as a vanadium(V)-hydrogen peroxide complex; the other metal ions are eluted later with stronger acids. Separations of vanadium(IV) or (V) from 25 metal ions are reported. Varying rations of vanadium(V) to iron(III) up to 1:100 are separated. (auth)

25485 A HIGHLY SPECIFIC METHOD OF SEPARATING CESIUM BY ION EXCHANGE ON THALLOUS PHOSPHOTUNGSTATE. Henri L. Caron (Woods Hole Oceanographic Institution, Woods Hole, Mass.) and T. T. Sugihara. Anal. Chem., 34: 1082-6(Aug. 1962).

Thallous phosphotungstate (TPT) is a highly specific cation exchanger for cesium. The heteropoly salt is converted into a form suitable for column use by mixing with paper pulp. The affinity of several monovalent ions for the exchanger is in the order Cs $\gg$ Ag > Rb > K. A simple method for obtaining essentially quantitatively a cesium fraction of high purity from virtually any starting solution is based on absorption on TPT, washing with 0.005M thallous nitrate which removes contaminants, and eluting cesium with 0.15M thallous nitrate. A major advantage over other methods using synthetic inorganic exchangers is that the final cesium fraction is obtained free of ammonium ion, a frequently used eluent which is troublesome to remove. The column retention capacity of TPT is 0.5, 0.3, and 0.1 meq per gram for cesium, rubidium, and potassium, respectively. (auth)

25486 SOLVENT EXTRACTION OF MONO(SALICYLATO)BERYLLIUM, AND THE pH TITRATION OF THE SYSTEM BERYLLIUM–SALICYLIC ACID. H. J. De Bruin, D. Kairaitis, and L. Szego (Australian Atomic Energy Commission, Sutherland, New South Wales). Australian J. Chem., 15: 218-27(May 1962).

It was found that a salicylatoberyllium complex can be extracted from aqueous solutions by aliphatic alcohols. The distribution ratio is a symmetrical function of the logarithm of the free ligand concentration and passes through a maximum value; the stability constants of the mono- and bis(salicylato)beryllium complexes were determined from the data for points of equal extraction. The values obtained in this way are $\beta_1 = 4.1 \times 10^{12}$ and $\beta_2 = 4.3 \times 10^{22}$, in an ionic strength of 0.15. They agree fairly well with those obtained by pH-titration procedures, which are $\beta_1 = 6.1 \times 10^{12}$ and $\beta_2 = 7 \times 10^{22}$. (auth)

25487 INTERACTION OF DILUTED SOLUTIONS OF URANYL SALTS WITH CHITIN AND SOME ESTERS OF CELLULOSE. P. F. Andreev, E. A. Plisko, and E. M. Rogozina. Geokhimiya, No. 6, 536-9(1962). (In Russian)

The mechanism of uranium isolation in a carbonatic (anionic) form from diluted solutions at pH-8 is investigated, i.e., for conditions frequently observed in nature. It is shown that such natural products as chitin and its derivatives are able to extract uranium in this form. Simple cellulose esters extract uranium in the cationic form much better. Chitin and its derivatives show equal ability for uranium extraction both in the cationic and in the anionic form. (auth)

25488 PREPARATION OF I-131 WITH HIGH SPECIFIC ACTIVITY. C. Chiotan, I. Dema, P. T. Frangopol, E. Gîrd, and V. Voicu. Intern. Chem. Eng., 2: No. 3, 357-9(July 1962). (In English)

A method for preparation of I^{131} from TeO_2 which was previously irradiated is described. The nuclear reactions for production of I^{131} are: $Te^{130}(n,\gamma) \rightarrow Te^{131} \rightarrow I^{131} + \beta^-$. The iodine was separated from the irradiated TeO_2 by wet distillation. The yield was approximately 75%. (M.C.G.)

25489 THE INFLUENCE OF DILUENT ON EXTRACTION OF EUROPIUM AND THORIUM NITRATES BY TRI-n-BUTYLPHOSPHATE. S. Siekierski (Inst. of Nuclear Research, Warsaw). J. Inorg. & Nuclear Chem., 24: 205-14(Feb. 1962). (In English)

The partition coefficients of europium and thorium extracted from 4 M $NaNO_3$ into 5% (by volume) TBP in a number of diluents were determined. Using the values of the partition coefficients and of the activity of TBP in the same diluents activity coefficients of the metal complexes in the organic phase were calculated. It was shown that both the activity coefficient of the complex in the organic phase and the activity of TBP are related to the solubility parameter of the diluent used. The influence of diluent on the partition coefficient is relatively small since both the activity of TBP and the activity coefficient of the complex change into the same direction with diluent. (auth)

25490 SOLVENT EXTRACTION IN THE SOUTH AFRICAN URANIUM INDUSTRY. P. J. Lloyd. J. S. African Inst. Mining Met., 62: 581-6(May 1962). (In English)

Economic and technological aspects of solvent extraction in relation to the existing ion exchange process in the South African uranium industry are discussed. Conclusions are that although the solvent extraction process seems to be the most feasible from economical and technological viewpoints, the process is not important enough to do away with the ion exchange process, however, the process may be used in conjunction with the ion exchange process. (N.W.R.)

25491 VAPORIZATION OF IMPURITIES IN COPPER, INCLUDING THOSE INTRODUCED BY ION BOMBARDMENT. E. Ruedl and R. C. Bradley (Cornell Univ., Ithaca, N. Y.). Phys. and Chem. Solids, 23: 885-90(July 1962). (In English)

A mass spectrometric analysis was made of particles sputtered and/or evaporated from the (221) plane of a high-purity single crystal copper surface in high vacuum. The results are relevant to such processes as heterogeneous catalysis and nucleation, as well as to the technique of cleaning solid surfaces by ion bombardment and annealing. Copper oxide layers may be completely removed from a copper surface (or at least reduced to a very small fraction of a monolayer) by repeated cycles of inert gas ion bombardment and annealing. During ion bombardment, particles of the bombarding beam and the ambient gas are physically trapped by the surface. These may be released from the copper by heating it to 200°C. The activation energy for this release is 0.3 ± 0.1 ev (measured only for argon). Sodium and potassium bulk impurities diffuse readily to the surface at a temperature of 600°C with activation energies of 2.8 ± 0.1 and 2.3 ± 0.1 ev, respectively. These same impurities also desorb from copper at 600°C with an activation energy (for potassium) of 1.2 ± 0.1 ev. The surface concentration of sodium and potassium, while always less than a monolayer, was never found to be zero; it was less after annealing, however, than after ion bombardment. (auth)

25492 RECENT DEVELOPMENTS IN SEPARATING TANTALUM AND NIOBIUM BY SOLVENT EXTRACTION. Joan L. Tews and Sherman L. May (Bureau of Mines, Albany, Ore.). p.1-18 of "Symposium on Columbium (Niobium) of the Electrothermics and Metallurgy Division of the Electrochemical Society," May 15 and 16, 1957, Washington, D. C. New York, John Wiley and Sons, Inc., 1958.

It was found that use of the solvent extraction system, $HF-H_2SO_4$–methyl isobutyl ketone, will yield more than 90% of the contained tantalum and niobium values free of each other and free of other metallic impurities irrespective of the tantalum to niobium ratio in the starting material. (auth)

25493 REACTOR FUEL PROCESSING. Technical Progress Review, Vol. 5, No. 2. Stephen Lawroski, ed. (Argonne National Lab., Ill.). Apr. 1962. 72p. $0.55 (GPO)(Domestic), $0.70(GPO)(Foreign).

Developments in reactor fuel processing are reported. Topics covered include: commercial aspects of fuel processing, research and development on aqueous and nonaqueous processing, waste disposal, and production of U, Th, Pu, and their compounds. (M.C.G.)

25494 SOLVENT EXTRACTION PROCESS FOR THE SEPARATION OF URANIUM AND THORIUM FROM PROTACTINIUM AND FISSION PRODUCTS. R. H. Rainey and J. G. Moore (to U. S. Atomic Energy Commission). U. S. Patent 3,049,400. Aug. 14, 1962.

A liquid-liquid extraction process was developed for recovering thorium and uranium values from a neutron irradiated thorium composition. They are separated from a solvent extraction system comprising a first end extraction stage for introducing an aqueous feed containing thorium and uranium into the system consisting of a plurality of intermediate extraction stages and a second end extraction stage for introducing an aqueous immiscible selective organic solvent for thorium and uranium in countercurrent contact therein with the aqueous feed. A nitrate ion-deficient aqueous feed solution containing thorium and uranium was introduced into the first end extraction stage in countercurrent contact with the organic solvent entering the system from the second end extraction stage while introducing an aqueous solution of salting nitric acid into any one of the intermediate extraction stages of the system. The resultant thorium and uranium-laden organic solvent was removed at a point preceding the first end extraction stage of the system. (AEC)

25495 SOLVENT EXTRACTION PROCESS FOR SEPARATING ACTINIDE AND LANTHANIDE METAL VALUES. Robert A. Hildebrandt, Herbert H. Hyman, and Seymour Vogler (to U. S. Atomic Energy Commission). U. S. Patent 3,049,402. Aug. 14, 1962.

A process of countercurrently extracting an aqueous mineral acid feed solution for the separation of actinides from lanthanides dissolved therein is described. The feed solution is made acid-deficient with alkali metal hydroxide prior to contact with acid extractant; during extraction, however, acid is transferred from organic to aqueous solution and the aqueous solution gradually becomes acid. The "acid-deficient phase" of the process promotes the extraction of the actinides, while the latter "acid phase" of the process improves retention of the lanthanides in the aqueous solution. This provides for an improved separation. (AEC)

25496 METHOD OF OPERATING A HEAVY WATER MODERATED REACTOR. H. C. Vernon (to U. S. Atomic Energy Commission). U. S. Patent 3,049,480. Aug. 14, 1962.

A method of removing fission products from the heavy water used in a slurry type nuclear reactor is described. According to the process the slurry is steam distilled with carbon tetrachloride so that at least a part of the heavy water and carbon tetrachloride are vaporized; the heavy water and carbon tetrachloride are separated; the carbon tetrachloride is returned to the steam distillation column at different points in the column to aid in depositing the slurry particles at the bottom of the column; and the heavy water portion of the condensate is purified. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

25497 (ACCO-66) LABORATORY SCALE ABRASIVE TESTS ON ION EXCHANGE RESINS. Topical Report. Hugh A. Ladner and George W. Lower (American Cyanamid Co. Atomic Energy Div. Raw Materials Development Lab., Winchester, Mass.). July 28, 1954. Contract AT(49-1)-533. 11p.

A laboratory scale test was devised to determine the relative physical stability of ion exchange resins designed for use in the resin-in pulp process for the recovery of uranium. The test was applied to four samples of Rohm and Haas XE-123 resin and one sample of Permutit SK resin. In addition it was shown that in a given sample of XE-123 resin, the larger the particle size of the resin, the greater was the abrasion loss. (auth)

25498 (AECL-1531) DECONTAMINATION OF BUILDINGS AND EQUIPMENT. J. Neil and A. M. Marko (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1962. 16p.

A description is presented of the facilities at Chalk River for decontamination of buildings and equipment and discusses briefly some of the special equipment developed to do the work. (auth)

25499 (ARGMA-TN-2H5N) INTERIM REPORT ON THE DESIGN AND CONSTRUCTION OF THE ARGMA 8,000-kw PLASMA FACILITY. J. J. Ehrlich, J. F. Perkins, C. M. Cason, and T. A. Barr, Jr. (Army Ordnance Missile Command, Redstone Arsenal, Ala. and Army Rocket and Guided Missile Agency, Redstone Arsenal, Ala.). Oct. 25, 1961. 21p.

Complete design considerations for the ARGMA 8,000-kw plasma facility are reviewed. Both facility requirements and performance characteristics are discussed for typical minimum energy ICBM and IRBM reentry trajectories. Calculated stagnation conditions are shown to be in the realm of modern plasma arc technology. Capability of the installed electric generation system is shown to be adequate to meet requirements. (auth)

25500 (KFK-69) LABORATORIEN FÜR ARBEITEN MIT RADIOAKTIVEN STOFFEN. BIBLIOGRAPHIE ÜBER PLANUNG, BAU, EINRICHTUNG U. AUSRÜSTUNG. (Laboratory for Work with Radioactive Materials. Bibliography on Planning, Construction, Arrangement, and Equipment). G. Brossmann (Kernforschungzentrum Karlsruhe, Germany). Nov. 1961. 286p.

A bibliography containing approximately 950 references on the design, construction, arrangement, and equipment for hot laboratories is presented. (N.W.R.)

25501 (MAB-139-M(M5)) STATE OF THE ART ON MACHINING. Fifth Progress Report by the Panel on Machining. (National Research Council. Materials Advisory Board). May 1, 1962. 48p.

The Panel on Machining reviewed the areas of conventional material-removal equipment, conventional material-removal processes, and alternative methods of material removal. Findings are presented with regard to the state of the art, major problem areas, and process growth potentials for the 1965-1980 period, as applicable to aerospace development. A major problem area which was recognized, is the lack of versatility in material-removal equipment for use in the production of small quantities of very complex parts utilizing a great diversity of materials. A need for closer tolerances on machined parts and a need for increased ability to machine high-strength, heat-resisting materials were also noted. It appears that there is good possibility of meeting a major part of these needs in the 1965-1980 period, if suitable large-scale imaginative research and development programs are carried forward. A later publication by the panel will offer suggestions for specific government-sponsored research programs recommended as necessary to meet these needs. (auth)

25502 (NAA-SR-Memo-6849) THE STEADY STATE STRUCTURAL EVALUATION OF THREE HIGH TEMPERATURE-HIGH PRESSURE SODIUM GENERATOR DESIGNS. R. M. Galantine and F. J. Waters (Atomics International, Div. of North American Aviation Inc., Canoga Park, Calif.) Apr. 30, 1961. Contract [AT(11-1)-GEN-8]. 42p.

A steady state structural evaluation was made of three sodium steam generator designs. One unit is of the stayed tubesheet design, another is of the j tube design, and the third generator is of the straight shell and tube design with a bellows in the shell. The feasibility of each design was established by studying the superheater component since it is subjected to the highest working temperatures. The evaluation was performed using methods and stress limitations specified by the ASME Unfired Pressure Vessels Code, Section VIII. To obtain a practical steam generator design for steam outlet conditions of 1075°F and 2500 psi, a material is required that has an allowable equivalent to that of 2¼ Cr−1 Mo and is compatible with sodium, steam, and the impurities normally found in these working fluids. (P.C.H.)

25503 (NP-11816) SOME COMMENTS ON CRATERING. Suffield Special Publication 22. G. H. S. Jones (Canada. Suffield Experimental Station, Ralston, Alberta) Apr. 26, 1962. 28p.

A discussion of large-scale craters is presented, dealing particularly with some aspects of the scaling problem. Techniques used to investigate certain types of crater, and the uncertainty in measurement and definition is stressed. Attention is directed mainly to craters produced by conventional explosives, but the discussion also includes comments on nuclear craters and high velocity impacts. (auth)

25504 (PAN-293/I-A) APPARATUS FOR PROCESSING NUCLEAR EMULSIONS. Bolesław Łyszczarz and Jan Turkiewicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1961. 7p.

An apparatus for processing nuclear emulsions was constructed and tested. The temperature cycle method is used in processing the plates. This method involves a cold stage in which the developer diffuses into the emulsion, and a warm stage in which development takes place. (J.R.D.)

25505 (TID-15986) THE LABYRINTH SEAL—THEORY AND DESIGN. A Literature Survey. Frederick Arnold and William K. Stair (Tennessee. Univ., Knoxville. Engineering Experiment Station). Mar. 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26; Subcontract 2118. 24p. (ME-5-62-1)

A literature survey, including 31 references, on labyrinth seals is presented. An analysis is suggested which provides design procedures for most engineering problems of current interest. Since the functioning of labyrinth seals is not completely understood, work on experimental coefficients for a wide range of geometries is suggested. (J.R.D.)

25506 (TID-15987) THE VISCO SEAL. A Survey. William K. Stair (Tennessee. Univ., Knoxville. Engineering Experiment Station). Mar. 1962. For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26]; Subcontract 2118. 41p. (ME-5-62-2)

The survey of the technical literature available on the visco seal suggested that the visco seal has definite potential for use on the compressors and turbines of gas-cooled reactors. The design example indicates that the clearances required for a visco seal can be made equal to or greater than those used for a bushing type seal. The visco seal can be constructed with a simpler auxiliary seal system than that currently in use with buffered type labyrinth and bushing seals and the seal can be designed to provide automatic static seals for zero shaft speed. The visco seal can operate in the turbulent range. (auth)

25507 (TID-15988) THE MECHANICAL FACE SEAL. A Survey of Sealing Theory. William H. Carden (Tennessee. Univ., Knoxville. Engineering Experiment Station). Mar. 1962. For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26]; Subcontract 2118. 9p. (ME-5-62-TN-3)

A review of literature was conducted on sealing theories which were proposed to account for conditions at mechanical seal interfaces. It is noted that the underlying theory of mechanical face seals appears to depend on conditions of the fluid between the faces. Although the basic principles of these seals are not well understood, a compromise between leakage and wear appears to be the practical operational answer. (J.R.D.)

25508 (TID-16158) COMMENTS ON THE USE OF "KODAK" AR.10 STRIPPING FILM IN AUTORADIOGRAPHY. Paul R. Burton and David L. Nelson (Saint Olaf Coll., Northfield, Minn.). [nd]. Contract AT(11-1)-1016. 9p.

Considerable success is reported with Kodak Fine Grain Autoradiographic Stripping Plates, AR.10 for studying the fate of radioisotopes in the tissues of small animals. Specific problems that arose in studying the uptake of exogenous C^{14}-labeled glucose by a parasitic worm maintained in vitro with the aid of radioautograms prepared with AR.10 stripping film are discussed. (C.H.)

25509 (TID-16274) A NEW PRINCIPLE FOR AIRBORNE CONTAMINATION CONTROL IN CLEAN ROOMS AND WORK STATIONS. W. J. Whitfield, J. C. Mashburn, and W. E. Neitzel (Sandia Corp., Albuquerque, N. Mex.). [July 1962]. Contract [AT(29-1)-789]. 28p. (SCDC-2626)

A new method is described for the control of airborne contaminants in clean rooms and work stations. The whole ceiling of the room is made of an air diffuser and the floor is made of grating with a rough filter material placed just below the grating floor. This filter traps particles as they are removed from the room and prefilters the air before it reaches the final filter. Absolute filters are located in the wall behind the work bench to move contamination generated by the worker away from the work area. A transistor telephone provides for room interior to exterior communication. Test results on a knock-down model are described. Sketches and photography show construction details. (C.H.)

25510 (DEG-Inf-Ser-262) METHOD OF INVESTIGATING AUTOMATIC CONTROL SYSTEMS CONTAINING LINEAR ELEMENTS WITH VARIABLE PARAMETERS. N. T. Kuzovkov. Translated by M. McCarthy (U.K.A.E.A. Development and Engineering Group, Risley, Lancs, Eng.) from Vestnik. Moskov. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim., No. 6, 19-30(1958). 18p.

The possibility of analysis of a system for automatic control consisting of a large number of constant elements and one or more variable elements by replacing the variable elements with constant elements equivalent to them in some way was investigated. A transfer function was derived and numerical examples are included. (M.C.G.)

25511 (FTD-TT-62-370) A MULTI-BEAM HIGH-VACUUM GAS DISCHARGE PUMP. E. M. Raykhrudel' and G. V. Smirnitskaya. Translated from U.S.S.R. Patent No. 139375. Jan. 10, 1961. 3p.

A high-vacuum pump is described in which the discharge tube is made with two mesh anodes and three flat cathodes, one of which is in the symmetry plane between the anodes and forms with the anodes, two discharge gaps in the overall magnetic gap. This design is superior to the ordinary multi-beam pump because of the increased active electrode surfaces and improved ionization in the discharge gaps. (J.R.D.)

25512 (NP-tr-887) THE EFFECTS EXERTED BY VARIOUS FACTORS ON THE COEFFICIENTS OF MIXING VELOCITY IN POWDER MIXERS. T. Yano, I. Kanise, and Y. Sanō. Translated by S. G. Brickley (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kagaku Kogaku, 24: 198-203(1960). 20p. (Includes original, 6p.).

Processes in the mixing of powders were examined kinetically from the shapes of the measured curves of mixing. The effects of various parameters of operation on the coefficient of mixing velocity were studied. Three distinct regions were observed on the mixing curves. (M.C.G.)

25513 (NP-tr-888) FLUIDIZATION TECHNIQUE APPLIED TO THE CONSTRUCTION OF A HIGH-TEMPERATURE THERMOSTATIC BATH. H. Kramers. Translated by E. Towndrow (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Génie chim., 77: No. 2, 25-33(Feb. 1957). 37p. (Handwritten MS. copy).

The construction and operation of a thermostatic bath with a fluidized bed as the thermostatic fluid are described. The bath may be useful for physical and chemical experiments and for precise thermal treatments particularly above 300°C. Discussions are included concerning fluidization requirements, calculation of heat requirements, and use of the automatic temperature control. (J.R.D.)

25514 (NP-tr-889) MIXING OF SOLID PARTICLES USING A RIBBON BLENDER. T. Yano, Y. Sanō, U. Shirakawa, and T. Tominaga. Translated by E. H. M. Colegrave (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kagaku Kogaku, 24: 219-25 (1960). 25p. (Includes original, 7p.)

An investigation is described in which samples of granular substances consisting of sodium carbonate and sand were used in a comparison of a ribbon blender mixing performance with earlier results obtained using rotary blenders. It was found that excluding the initial stages of the mixing curve, it is analogous to the mixing curves obtained for rotary mixers. (J.R.D.)

25515 (NP-tr-892) ULTRA-PRESSURES. Jacques Basset. Translated for U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng. from Atomes (Paris), 12: 131-5(Apr. 1957). 20p. (Includes original, 5p.). (Handwritten MS. copy)

Developments in ultra-high-pressure techniques are surveyed. The methods and problems in the range of 10,000 to 50,000 atm are described. The problem of finding a fluid or plastic capable of transmitting the pressure hydraulically in the range 50,000 to 100,000 atm is discussed. Methods of obtaining pressures above 100,000 atm are de-

scribed. Development of a laboratory chamber working at very high pressures and measurement of high pressures are discussed. Descriptions are given of free-piston and electrical-resistance gages. (M.C.G.)

25516 CRYOGENIC ENGINEERING IN NUCLEAR ROCKETRY. F. J. Edeskuty and E. F. Hammel (Los Alamos Scientific Lab., N. Mex.). Cryogenics, 2: 193-203 (June 1962).

Reasons for the importance of cryogenics in nuclear rocketry are reviewed. Nuclear rocket test facilities and associated cryogenic equipment are described. Typical cryogenic problems are discussed. (L.N.N.)

25517 INERT ATMOSPHERES IN NUCLEAR ENERGY. P. A. F. White and S. E. Smith (Atomic Weapons Research Establishment, [Aldermaston, Eng.]). Nuclear Eng., 7: 284-8(July 1962).

Some of the situations in nuclear technology in which inert atmospheres are desirable or necessary are outlined. An account is given of the principles involved in the creation of inert atmosphere conditions. General solutions are indicated to some of the problems raised by the use of such atmospheres. Particular attention is given to inert-gas purification and impurity detection, as well as the problem of supplying inert gas to the workspaces. (T.F.H.)

Heat Transfer and Fluid Flow

25518 (AEEW-R-142) THE TRANSITION FROM FLOODING TO UPWARDS COCURRENT ANNULAR FLOW IN A VERTICAL PIPE. G. B. Wallis (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Feb. 1962. 16p.

The limits of countercurrent flow in a vertical pipe were related to the onset of cocurrent upward annular flow. The results were confirmed by evidence from several sources and lead to the criterion $V_g = (0.8 \rightarrow 0.9)\rho_g^{-1/2} \times [D_g(\rho_f - \rho_g)]^{1/2}$ for the minimum gas superficial velocity which will support a liquid film in cocurrent flow. (auth)

25519 (AERE-R-3808) PRESSURE DROP DATA FOR THE FORCED CONVECTIVE FLOW OF STEAM/WATER MIXTURES IN VERTICAL HEATED AND UNHEATED ANNULI. J. G. Collier (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 95p.

Data are presented for pressure drop in steam-water mixtures flowing in vertical annuli at pressures up to 80 psia, with and without heat addition. Preliminary analyses are based on the homogeneous and Lockhart-Martinelli models. (auth)

25520 (AERE-R-3921) TECHNIQUES FOR LIQUID FILM AND PRESSURE DROP STUDIES IN ANNULAR TWO-PHASE FLOW. G. F. Hewitt, R. D. King, and P. C. Lovegrove (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1962. 95p.

Work is described which is concerned with developing and improving new techniques for studying annular flow. Surface waves were investigated using the needle contact method, and techniques using up to four conductance probes simultaneously were developed. It is noted that the work is incomplete but it is the basis for considerable further research. (J.R.D.)

25521 (ARF-1167-18) FEASIBILITY STUDY OF A NEW MASS FLOW SYSTEM. Final Report, June 1, 1960 to November 31, 1961. J. W. Haffner (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 31, 1962. Contract AT(11-1)-578. 98p.

A program of research and development activity was undertaken to demonstrate the feasibility of a new mass flow metering technique. A function (ρv^2) of flow velocity (v) and density (ρ) is measured by means of passing a fluid through a curved section of pipe and measuring the resulting rotational torque. This signal is multiplied by the fluid density (ρ) which is measured by means of a self-referenced, gamma-ray absorption densitometer. The square root of this product is extracted to yield a readout for mass flow rate. Mass flow rate is integrated to provide a readout for mass flow quantity. The initial design goal of $^3/_4\%$ accuracy was attained and verified by an extensive series of tests. The results of these and other tests demonstrated the feasibility of the proposed technique and established it as a new mass flow metering principle. (auth)

25522 (ASD-TR-61-594) LITERATURE SURVEY ON LIQUID METAL BOILING. Final Report-Phase I. Richard E. Balzhiser, John A. Clark, C. Phillip Colver, Edward E. Hucke, Herman Merte, Jr., Lowell R. Smith, and Andrew S. Teller (Michigan. Univ., Ann Arbor. Coll. of Engineering). Dec. 1961. Contract AF 33(616)-8277. 157p. (AD-270481)

A survey was made of information pertaining to the current status of liquid-metal-boiling technology. Material pertaining to boiling and two-phase-flow phenomena are also included, and existing correlations for predicting heat transfer coefficients in the nucleate- and film-boiling regimes are summarized. Correlations which predict the critical heat flux (or burnout flux) are presented and compared with experimental data available. The use of liquid metals as fluids in space-oriented Rankin cycles is considered, and interfacial considerations of possible importance are cited and discussed. Particular attention is called to the solid-liquid interfacial energy and its importance in limiting heat transfer across the interface. A summary of physical properties for various liquid metals and water is presented along with 1191 references to books, reports, journals, and theses published from approximately 1930 to 1961. (P.C.H.)

25523 (CRFD-1075) HEAT TRANSFER COEFFICIENT BETWEEN UO_2 AND ZIRCALOY-2. A. M. Ross and R. L. Stoute (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1962. 72p. (AECL-1552)

Experimental values of the heat-transfer coefficient between UO_2 and Zircaloy-2 surfaces in contact under conditions of interfacial pressure, temperature, surface roughness and interface atmosphere, that are relevant to UO_2/Zircaloy-2 fuel elements operating in pressurized-water power reactors are given. Coefficients were obtained from eight UO_2/Zircaloy-2 pairs in atmospheres of helium, argon, krypton, or xenon, at atmosphere pressure and in vacuum. Interfacial pressures were varied from 50 to 550 kgf/cm^2 while surface roughness heights were in the range 0.2×10^{-4} to 3.5×10^{-4} cm. The effect on the coefficients of cycling the interfacial pressure, of interface gas pressure, and of temperature were examined. Experimental values of the coefficients were used to test the predictions of expressions for the heat-transfer between two solids in contact. For the particular UO_2/Zircaloy-2 pairs examined, numerical values were assigned to several parameters that related the surface roughnesses to either the radius of solid/solid contact spots or to the mean thickness of the interface voids and that accounted for the imperfect accommodation of the void gas on the test surfaces. (auth)

25524 (KAPL-2206) COMPARISON OF METHODS OF INTEGRATING THERMAL TRANSPORT EQUATION. W. B. Jordan (Knolls Atomic Power Lab., Schenectady, N. Y.). June 22, 1962. Contract W-31-109-eng-52. 31p.

First-order methods for the solution of the thermal-transport equation were analyzed to determine their performance. Criteria for convergence and freedom from oscillation are stated. Formulas for both transient response and frequency response were developed. Curves comparing the performance of six selected formulas are presented. (auth)

25525 (NAA-SR-Memo-6928) CRITICAL HEAT FLUX IN POOL BOILING — EFFECT OF GEOMETRY AND HEATER CHARACTERISTICS. G. C. Pinchera (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 21, 1961. Contract [AT(11-1)-Gen-8]. 37p.

A comparative study was initiated to check the consistency and reliability of the suggested mechanisms and correlations for pool boiling on the basis of available experimental data. As the data present a high degree of scattering, the contribution to this scatter by such parameters as geometry and heater characteristics was investigated. Geometrical parameters such as orientation of the heating surface, heater size, liquid level, boiler shape and size, and heater characteristics such as material, roughness, aging and cleanliness of the surface, and thermal characteristics were considered. The critical heat flux in pool boiling depends essentially on the coolant properties. Another parameter that has some influence is the heater geometry. The size of the heater and, for very thin walls, the thickness have a definite effect on the critical heat flux. Horizontal and sufficiently long vertical tubes seem to give essentially the same values. Some increase in the critical heat flux appears to occur along with the fouling of the heating surface. The critical heat flux is essentially independent of the material for most cases, but inexplicably high values were observed for some materials. (auth)

25526 (NYO-9649) HEAT TRANSFER AND PRESSURE DROP IN ECCENTRIC ANNULI. Theodore Diskind (Columbia Univ., New York. Engineering Research Lab.). Sept. 30, 1961. Contract AT(30-3)-187. 91p. (CU-1-61-AEC-187-Ch.E.).

Experiments are described in which heat transfer and pressure drop measurements were made for water flowing in eccentric annuli. The heat transfer experiments were performed in an annulus having a radius ratio of 1.5 at eccentricities up to 92%. Surface temperatures were measured at chosen points along the annulus axis and around the annulus circumference. Detailed measurements are presented in tabular form and selected data are illustrated graphically. A method is presented for correlating and predicting heat transfer coefficients and temperature distributions in the annulus studied. (auth)

25527 (RM-2852-PR) INFORMATION ON THE 1961 MINSK CONFERENCE ON HEAT AND MASS TRANSFER WITH PHASE AND CHEMICAL CONVERSIONS. Joy B. Gazley and Carl Gazley, Jr., comp. (RAND Corp., Santa Monica, Calif.). Nov. 1961. Contract AF 49(638)-700. 65p.

An annotated bibliography of 320 papers presented at the conference is presented. Complete proceedings of the conference will be published in a Russian book and probably in English translation as well. (N.W.R.)

25528 (WAPD-T-1502) MEASUREMENT OF SOME BASIC PARAMETERS IN TWO PHASE ANNULAR FLOW. E. R. Quandt (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1962. Contract AT(11-1)-Gen-14. 38p.

The experimental results of vertical flow of air-water mixtures in a $\frac{1}{4} \times 3$ in. rectangular channel are presented. It is assumed that annular flow is adequately described by a liquid film on the channel walls flowing concurrently with a central core of vapor and droplets. Dye injection into the liquid film is used as a means of measuring the film velocity and thickness, fraction of liquid entrained in the gas, droplet axial velocity, and rate of droplet interchange between the core and the film. Pressure gradient and liquid volume fraction were also measured. Air velocities from 50 to 200 ft/sec and total liquid rates from 0.04 to 0.60 lb per sec per ft of perimeter were studied. Visual observations indicated that the most important characteristic of this flow regime is the surface waves generated by the gas flow over the liquid film. It is shown that the average values of film thickness and velocity may be used to compute the wall shear stress and that the film flow is laminar. The measured rates of droplet interchange indicate that this flow is too small to account for the film to gas core momentum transfer, but is significant from a heat transfer standpoint. The droplet cross-flow rates behave in the anomalous manner deduced by Isbin and Vanderwater from an analysis of burnout data. (auth)

25529 (AEC-tr-5214) TURBULENT FLOW IN CIRCULAR TUBES. V. I. Smirnov and V. G. Nevzglyadov. Translated for Oak Ridge National Lab., Tenn. from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, No. 9, 857-74 (1945). 35p.

A theoretical investigation was made of the steady flow of an incompressible viscous fluid through a straight tube of circular cross section with smooth walls. The profile of average velocities and other characteristics of turbulent flow were derived. The results of calculations were compared with experiments. Use of the statistical theory made it possible to transform the solution obtained into equations which agreed with the semi-empirical equations of Nikuradse. (M.C.G.)

25530 (EURAEC-42) RESULTS OF WET STEAM COOLING EXPERIMENTS: PRESSURE DROP, HEAT TRANSFER AND BURNOUT MEASUREMENTS WITH ROUND TUBES. Special Report No. 2. L. Berkowitz, S. Bertoletti, J. Lesage, G. Peterlongo, G. Soldaini, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Oct. 1960. Work Performed under United States–Euratom Joint Research and Development Program. Contract 002-59-11RDI. 253p. Translation of CISE-R-27.

Research progress on heat transfer in two-phase flow is reported. The facility, experimental procedure, calculation of physical properties, and range of experiments are described. Error analysis is discussed. Data on two-phase steam-water heat transfer in tubular round elements are presented in tables and graphs. (M.C.G.)

25531 A PHYSICAL MODEL FOR NUCLEATE BOILING HEAT TRANSFER FROM A HORIZONTAL SURFACE. E. Ruckenstein. Bul. inst. politeh. Bucuresti, 23: 79-85 (July-Sept. 1961). (In English)

An equation for the heat transfer coefficient from a horizontal surface is established on the basis of a physical model for the nucleation and hydrodynamical process. (auth)

25532 MASS AND HEAT TRANSFER THROUGH FIXED AND FLUIDIZED BEDS. Ashis Sen Gupta and George Thodos (Northwestern Univ., Evanston, Ill.). Chem. Eng. Progr., 58: No. 7, 58-62(July 1962).

Mass and heat transfer data available in the literature for

gases and liquids flowing through fixed and/or fluidized beds consisting of spheres, cylinders, cubes, Rashig rings, partition rings, and Berl saddles were reviewed and correlated for different geometrical configurations to produce a single relationship for mass transfer and a similar relationship for heat transfer. (auth)

25533 ELECTROCONVECTION EFFECTS ON HEAT TRANSFER. E. Bonjour, J. Verdier, and L. Weil (Centre d'Etudes Nucléaires, Grenoble, France). Chem. Eng. Progr., 58: No. 7, 63-6(July 1962)

Electroconvection effects on the heat transfer coefficient for dielectric liquids were quantitatively studied by observing the boiling phenomenon and performing experiments on liquids with diversified characteristics. Notable improvements in the exchange coefficients ranging by factors from 4 to 10 may be obtained. The mechanisms connected with each fluid characteristic and leading to such improvements are presented. (auth)

25534 THERMAL PROPERTIES OF AIR-COOLED GRAPHITE CHANNELS. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 13: 275-82(July 1962). (BNL-5522)

A summary is given of work on the thermal behavior of air-cooled graphite channels. The differences in results caused by different models used are discussed. The results reported, and evaluation of a particular model, indicate that the studied model is not confirmed by experiment and does not predict the limit in permissible temperatures imposed by graphite oxidation in air-cooled graphite moderated reactors. (auth)

25535 HEAT TRANSFER IN SODIUM–POTASSIUM ALLOY. R. A. Baker and Alexander Sesonske (Purdue Univ., Lafayette, Ind.). Nuclear Sci. and Eng., 13: 283-8 (July 1962).

To provide heat transfer data of high precision for Na-K heat exchange systems, a Na-K heat transfer loop was designed to minimize experimental errors and yield results with a high degree of reproducibility. Average heat transfer coefficients were determined for both tube and annulus in a horizontal, concentric-tube, Na-K (56% K)-to-Na-K exchanger. The results after correction for entrance effects were described by the following empirical relations: $N_{Nu} = 6.05 + 0.0074\ N_{Pe}^{0.95}$ (tube); and $N_{Nu} = 0.80(d_2/d_1)^{0.3}[5.12 + 0.0296\ N_{Pe}^{0.785}]$ (annulus), where N_{Pe} was the Peclet number and d_1 and d_2 were the inner and outer diameters of the annulus respectively. No distinction was found between the Nusselt moduli (N_{Nu}) measured at uniform heat flux and those measured at variable heat flux. No change in the experimental Nusselt moduli was observed when the oxide content was varied between 0.0025 and 0.006 wt.% oxygen. (auth)

25536 TEMPERATURE HISTORIES OF INTERNALLY HEATED THIN BODIES COOLED BY CONVECTION AND/OR THERMAL RADIATION. Walter Unterberg (North American Aviation, Inc., Canoga Park, Calif.). Nuclear Sci. and Eng., 13: 296-7(July 1962).

The temperature variation of a thin body (i.e., one that has high thermal conductivity and small dimensions along any heat flow direction) with time is found as $dT/dt = X - YT - ZT^4$, where X, Y, and Z are constants that depend on the heat generation in the body, the convective cooling, and the radiative cooling respectively, and t and T are time and temperature respectively. Solutions are found to this equation for combined convection and radiative cooling (constant X, Y, and Z); radiative cooling only (X and Z constant and Y = 0); and several cases with convective cooling only (Z = 0, and various conditions on X and Y). The existence of a maximum temperature is studied for each of these cases, by setting $dT/dt = 0$. (T.F.H.)

25537 THE STABILITY OF VISCOUS FLOW BETWEEN ROTATING CYLINDERS. [PART] II. S. Chandrasekhar and Donna D. Elbert (Univ. of Chicago). Proc. Roy. Soc. (London), A268: 145-52(July 10, 1962).

A new method is described for solving the characteristic value problem underlying the theory of the stability of viscous flow between rotating cylinders. The method depends on solving a simpler adjoint system of equations. It is shown that the present method is superior to the one described by Chandrasekhar. Numerical results are given for the case when the ratio of the radii of the two cylinders is one-half. (auth)

25538 IMPROVEMENTS IN OR RELATING TO FLUID FLOW CONTROL SYSTEMS. Walter John Cairns and Everett Long (to United Kingdom Atomic Energy Authority). British Patent 901,798. July 25, 1962.

A control system is designed for fluid flow through a duct, particularly from a heat exchanger into an impeller. The system includes a shaft rotatable about the longitudinal axis of the duct, a plurality of flow control vanes in the duct, and means for rotating the vanes. (D.L.C.)

Instrumentation

Refer also to abstracts 25893, 25904, 25907, 25925, 25940, 25944, 25948, and 26486.

25539 (AD-269391) LOW MAINTENANCE MACHINERY FOR SUBMARINE POWER PLANTS. APPENDIX 4. POWER CONTROL OF THE DOUBLE-ACTING "STEAMOTOR." F. J. Neugebauer (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Sept. 1961. 6p.

Steamotor control by variable cut-off and throttling is discussed. (auth)

25540 (AD-269401) CONDENSER ANALYSIS. APPENDIX 14. F. J. Neugebauer (General Electric Co. General Engineering Lab., Schenectady, N. Y.). May 1961. Contract Nonr-3485(00). 37p.

Two nomograms were developed which allow rapid calculations of condenser size and performance for advanced condensers which apply unconventional means of securing heat-transfer performance. Sample calculations are included. (M.C.G.)

25541 (AEEW-R-107) A COMPREHENSIVE TEST SPECIFICATION FOR PULSE FISSION COUNTERS. D. L. Roberts (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Feb. 1962. 19p.

The following test specification contains a standard acceptance test procedure for the U.K.A.E.A. designed pulse fission counters now commercially available. This test specification may be used for any pulse fission counter provided a specification sheet is supplied to the contractor quoting this report and including specified values for the measured quantities. (auth)

25542 (AEEW-R-150) A TECHNIQUE FOR RAPID EMERGENCY AIR SAMPLING. J. F. Croft and K. E. G. Perry (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1962. 17p

Following an accidental release of airborne radioactive contamination, a rapid estimate is required of the level and distribution of the inhalation hazard. A measurement

technique is described which gives a continuous and virtually instantaneous indication of the levels of alpha and beta activity in the air. A correlation between the observed instrument response and the appropriate urgency of emergency action is proposed. (auth)

25543 (AEEW-R-154) A PROPOSED APPROACH FOR THE DERIVATION OF A SYSTEM TRANSFER FUNCTION BY THE USE OF AN EXTERNAL NETWORK. C. B. Guppy (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1961. 27p.

A method is outlined which might have some application for transfer function analysis of a given system. It consists of using the system itself in a general external feed-back, feed-forward circuit. The coefficients of the external circuit are set up one at a time to produce recognizable steady states at the output terminals of the external circuit. In effect step by step neutralization of the system under test is achieved in the external circuit by setting up the inverse transfer function. (auth)

25544 (AFCRL-62-2) STUDIES OF ELECTRON TUBE MATERIALS AND THERMIONIC EMISSION PROCESSES. Scientific Report No. 7, October 1, 1961–December 31, 1961. (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Dec. 29, 1961. Contract AF19(604)-7286. 27p. (AD-271101)

The thermionic emission properties of ultra-pure Ni based oxide cathodes in the clean test diode are being investigated. The effects of processing, activation, and life conditions on thermionic emission such as improvement in the cleanliness of the diode system by pre-processing the bulb, stem and supporting elements prior to final assembly of the test diode, dependence of the electrolytic activation process on cathode temperature, anode voltage and anode current, and operation of the test diodes during life both with and without anode voltage are being investigated. The method which was developed for measuring the evaporation of active material from dispenser cathodes is now being extended to the more difficult problem of measuring sublimation of active material from oxide cathodes. Preliminary results on the evaporation of Ba and/or BaO were obtained for passive and active metal base oxide systems such as BaO on Pt, BaO on ultra-pure Ni rod (rod 21), BaO on active N4 Ni, BaO on Ta, C-10 triple oxide coating on ultra-pure Ni (rod 21), and C-10 on N4 Ni. Two phenomena reported earlier were interpreted. One is the enhancement of emission and uniformity of emission after exposure to a minute oxygen pressure in the hot state of the thin Ba-coated polycrystalline ultra-pure Ni structure. The other is the displaying, by means of thermionic electrons, of domain patterns of selective magnetic surface spins of Ni lattice atoms. (auth)

25545 (AFOSR-2418) SPURIOUS SPECTRAL EFFECTS AND ALIGNMENT PROCEDURES IN X-RAY SPECTROMETRY. Research Report No. 13. Herbert W. Schnopper (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Apr. 15, 1962. Contract AF 49(638)-402. 87p.

Spurious spectral effects of vertical divergence and improper spectrometer alignment (crystals and x-ray beam) are discussed. Distortions produced in such spectral features as Bragg angle, line shape, width, and asymmetry are illustrated both theoretically and experimentally. A new method is described for aligning the crystals, which makes use of the non-dispersive (1,-1) position, and which is independent of vertical divergence. Significant new conclusions are the crystal alignment and the beam alignment must be treated separately and with equal care, and perfect crystal alignment cannot be conveniently achieved in the presence of vertical divergence. Quantitative discussion is given of the spectral distortions which arise from vertical divergence even for perfect alignment of the crystals and of the x-ray beam. (auth)

25546 (AFOSR-3030) DELINEATION OF TRACKS OF HEAVY COSMIC RAYS AND NUCLEAR PROCESSES, WITHIN LARGE CRYSTALS OF SILVER CHLORIDE. Charles B. Childs (North Carolina. Univ., Chapel Hill and National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.) and Lawrence M. Slifkin (North Carolina. Univ., Chapel Hill). July 1962. Contract AF 49(638)-865. 20p.

Tracks of energetic charged particles, such as heavy primary cosmic rays and the products of nuclear collisions, were made visible within the interior of large, transparent crystals of silver chloride. The tracks are delineated by photoelectric formation of metallic silver along them. The technique may be useful as a convenient and distortion-free method for the study of heavy primaries and fission fragments. (auth)

25547 (AROD-2302.8) INVESTIGATION OF PHYSICAL PROPERTIES OF SOLIDS BY ULTRASONIC METHODS. Final Report for the Period ending February 28, 1962. Rohn Truell (Brown Univ., Providence). 6p.

An outline of the work undertaken is presented along with a brief summary of the results. Most of the technical material was presented in technical reports and articles. Certain properties of solid materials were studied primarily by means of high frequency ultrasonic methods. In particular this work was concerned with study of ferromagnetic behavior in Ni single crystals at low temperatures; the interaction of stress waves and electromagnetic waves in piezoelectric semiconductors such as CdS, i.e., interaction of stress waves with charge carriers; phase changes in quartz and CdS; phonon-phonon interaction in insulators and semiconductors. (auth)

25548 (AROD-2763.9) ESTIMATION OF THE STRENGTH OF A RADIOACTIVE SOURCE. Technical Report No. 54. Kimiko O. Bowman and H. A. David (Virginia. Agricultural Experiment Station, Blacksburg). July 1962. 34p.

Estimation is made of the strength of a radioactive source when decay is rapid so that the usual assumption of a Poisson distribution of counts is not applicable. Two main cases distinguish background radiation as small and large. In the former case, the common procedure of simply subtracting off a constant background radiation is adequate. If the background radiation is neglected altogether, the method of maximum likelihood may be used to estimate both source strength and decay-constant for counts taken at any arbitrary times. The large-sample variances and covariances of these estimates are obtained and the procedure illustrated on an actual set of experimental results. When the background radiation is large, the random fluctuations should be taken into account. The method of maximum likelihood applied in conjunction with the assumption of normality of total counts is compared with the Tandberg procedure in a numerical example, where the difference turns out to be unimportant. The possibility of taking two counts is also considered and source strength estimated by a least squares approach. Attention was concentrated on problems caused by the rapid decay of radioactive source. (auth)

25549 (ASD-TDR-62-52) NEUTRON-GAMMA RAY SPECTROMETER. J. D. Hall and J. B. Ashe (Texas Nu-

clear Corp., Austin, Tex.). Apr. 1962. Contract AF 33 (616)-7787. 30p.

The design of a neutron-gamma ray spectrometer is described. The spectrometer employs pulse shape discrimination in an organic scintillator detector to selectively detect neutrons or gamma rays in a mixed field by a method not utilizing space charge limiting. Selective detection may be obtained for neutrons of energy higher than 0.7 Mev and for gamma rays above 0.25 Mev. Spectral information is usuable to 15 Mev for neutrons and to 4 Mev for gamma rays. Detection efficiencies range from about 6 to 30%. Typical spectra, data analysis procedure, and operating characteristics of the spectrometer are presented. (auth)

25550 (CEA-2128) ADAPTATION DE LA MECANOGRAPHIE POUR LA COMPTABILISATION DES DOSES INTEGREES. (Adaptation of Mechanography to the Measurement of Integrated Doses). R. Tabardel-Brian and J. Dulau (France. Commissariat à l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chuscian). 1962. 12p.

Because of the increasing number of workers exposed to nuclear radiation, and with a view to avoiding doses above the maximum permissible dose for these workers, it was necessary to find a system whereby the total irradiation assimilated during periods of 3 and 12 consecutive months could be known and circulated rapidly, within 48 hours. The method chosen for this requires the services of the Mechanographic service of the Marcoule Center. The present article describes the mechanographic solution to this problem. (auth)

25551 (CRRP-1086) FOG DENSITY MEASUREMENT BY X-RAY SCATTERING. J. G. Bayly (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1962. 17p. (AECL-1522)

A proposed method is described for measuring the average density of the fog near the centers of pipes. The steam quality can be estimated for pipes in which the slip is known. The fog density is found by measuring the amount of radiation scattered when a collimated gamma radiation beam is passed through the system. Further development of the method is needed for optimization and to extend the technique to smaller tubes. (J.R.D.)

25552 (D1-82-0173) THE PARALLEL PLATE PLASMA PROBLEM. Richard B. Hall (Boeing Scientific Research Labs., Seattle). June 1962. 51p.

The parallel plate plasma problem is considered under the assumption of uniform density and a specular reflection boundary condition at the plates. The impedance of the device is derived for several different models of the plasma medium. The impedance of a hydromagnetic medium exhibits resonances whenever the plate separation is an odd multiple of a half wavelength while the Boltzmann equation yields similar results which include the presence of losses in a collisionless plasma. The predicted resonances in the impedance can most likely be observed at high frequencies where only electron motion is important. The low-frequency resonances would be very difficult to observe in gas-discharge plasmas because of the high collision frequencies and because the resonances occur at small wavelengths. The impedance of the plasma capacitor based on the Boltzmann equation is derived by use of Fourier series techniques and leads to a natural determination of an equivalent circuit of the device which is useful for physical understanding. It is also possible to analyze the plasma capacitor by use of a method first derived by Landau in which an integral equation is obtained. The plasma capacitor impedance was obtained by this method only for a simple rectangular distribution function. In this case the hydromagnetic and Boltzmann equations yield identical results because the perturbed pressure is proportional to the perturbed density. By use of hydromagnetic equations, the cold plasma impedance for a uniform and nonuniform d-c density distribution are compared and shown to agree. (auth)

25553 (GCA-TR-61-19-N) VACUUM GAUGE CALIBRATION SYSTEM. Wallace S. Kreisman (Geophysics Corp. of America, Bedford, Mass.). Dec. 1961. Contract NAS5-270. 82p.

A unique system for pressure gauge calibration was developed. The system is a glass and metal, ultra-high vacuum system whose essential vacuum components may be baked out, at temperatures up to 450°C, in order to minimize contamination of the gases used for calibration. The system can produce pressures ranging from one atmosphere (760 torr) to ultra-high vacuum (10^{-7} torr) with high accuracy. Two different types of pressure standards are used in the system: a mercury manometer, and a set of three McLeod gauges. The standards cover different, but overlapping pressure ranges so that the gauges can be cross calibrated and ultimately referenced to the mercury manometer. A Vseco, RG-75 ionization gauge, calibrated with the system, is used as a secondary system standard. During system calibration a thorough search was made for possible sources of error in McLeod gauge measurements Experiments indicated the chief source of error to be systematic errors in the observed final pressure of the gas in the closed-end capillary of the gauge. A powerful method for determining this error was developed during the study. Using this technique the gauge error can be determined for the particular gauge used the the pressure being measured. Experiments verify that once the gauge error is determined, measurements made with two or more well-calibrated gauges, having different dimensions, lead to a single, unequivocal value of the measured pressure. The method also provides a useful tool for future studies of these systematic errors. Several Bayard-Alpert type ionization gauges were calibrated with the system for the pressure range between 10^{-3} and 10^{-6} torr. (auth)

25554 (HASL-118) THE EFFECT OF NOISE ON PULSE HEIGHT RESOLUTION. Irving M. Meth and Robert T. Graveson (New York Operations Office. Health and Safety Lab., AEC). Jan. 1962. 17p.

A statistical study of base line fluctuations was used to relate noise measurements with the resolution spread of a pulse height analysis system. The resolution was inversely proportional to the signal-to-noise ratio. The proportionality constant was derived on the basis of a normal amplitude distribution for noise. A review of noise measuring techniques is given and adapted for use with electronic voltmeters. The form factors required to interpret meter readings in terms of the rms value of noise are described. (auth)

25555 (IDO-16783) THE GENERATION OF POISSON TIME DISTRIBUTED RANDOM PULSES. Ned Wilde (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1, 1962. Contract AT(10-1)-205. 35p.

The need for a source of pulses randomly distributed in time according to the Poisson distribution is discussed. A theoretical analysis showed that these pulses may be generated by employing an electrical "white noise" source. Calculations indicated the feasibility of a generator capable of producing Poisson pulse at a maximum average rate of one megacycle. The results of laboratory experiments

support the calculations and demonstrate the inadequancy of using periodic pulses to determine instrument response to random pulses. A design of a nuclear signal simulator incorporating the Poisson pulse generator is suggested. (auth)

25556 (IDO-16784) DATA ANALYSIS TECHNIQUES FOR GAMMA-RAY SCINTILLATION SPECTROMETRY. R. L. Heath (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 29, 1962. Contract AT(10-1)-205. 11p.

A series of computer programs are described which were successfully applied to the reduction of pulse-height data using digital computers. Calculations carried out by these programs include: determination of pulse height vs energy response of an NaI detector; calculation of coincidence sum spectra; and the analysis of complex pulse-height spectra to obtain energies and relative intensities of individual gamma rays or relative abundances from a mixture of radionuclides. Measurement problems and instrumental requirements are discussed in detail. (auth)

25557 (JAERI-1030) THE CONSTRUCTION AND PERFORMANCE OF THE JAERI NEUTRON CRYSTAL SPECTROMETER. Yoshihisa Ohno, Tetsuo Asami, Koichi Okamoto, and Kazumi Ideno (Japan Atomic Energy Research Inst., Tokyo). Mar. 1962. 42p. In Japanese.

The JAERI Crystal Spectrometer is similar to the high resolution spectrometer in the Brookhaven National Laboratory. The spectrometer was constructed to be used in combination with the reactor JRR-2, a CP-5 type reactor of 10 Mw which is now under construction. Some preliminary experiments and the measurement of the pile neutron spectrum at the experimental beam hole were performed at the JRR-1 reactor (Water Boiler type of 50 kw), using a LiF single crystal of 8 cm × 8 cm × 1 cm. The full width at the half maximum intensity was 24 minutes of arc. The construction of the spectrometer, the detail procedures of the instrumental alignment, and the performance characteristics using a LiF crystal are described. The relative reflectivity of the LiF crystal in the various lattice planes for the slow neutron and the counting efficiency of the detector were calculated. Furthermore, a spectrum measurement of the neutrons at an experimental hole of the reactor JRR-1 and the transmission measurement of Cd and In near the lowest neutron resonances were carried out. (auth)

25558 (JINR-P-979) REGISTRATSIYA DELENIYA YADER V USLOVIYAKH BOL'SHOGO FONA. (Recording of Nuclear Fission Fragments in Conditions with Strong Background). S. P. Almazova and V. P. Perelygin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 11p.

To measure the spontaneous fission periods of Np^{237}, Pu^{239}, and Pu^{242} and to identify spontaneous fission acts with anomalously short lifetime, a technique was worked out for removing the background due to light charged particles and γ rays. This technique also records simultaneously the tracks of nuclear fission fragments. Using the method of latent image oxidation and underdevelopment, tracks of fission fragments were recorded on nuclear plates against a background of 10^{10} to 10^{11} α or γ per cm^2 (about 100 thousand roentgen). (auth)

25559 (NAMC-ASL-1050(Pt.II)) DEVELOPMENT OF RESISTANCE STRAIN GAGES USABLE UP TO 1600°F. W. H. Graft and W. H. Colner (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Dec. 1957. Contract N156S-32317. 42p.

Results of work on the development and testing of an electrical strain gage usable up to 1600°F are summarized. An evaluation was made of two alloys in the system Fe–Cr–Al, Alloy B (Fe-25 Cr-7 ½ Al) and Alloy D (Fe-20 Cr-10 Al). The alloys were reduced to 0.001-inch diameter wires suitable for strain sensitivity determinations and resistance stability tests. Gages of both Alloys B and D were tested in a grid configuration on base materials of Type 302 stainless steel (18-8), Titanium Alloy C 110M and Udimet 500 Alloy. Test temperatures up to 1400°F were investigated, and strain values up to approximately 2200 microin/in. were used. Comparable gage factors were found for both alloys, approximately 2.0, and the effect of temperature or strain level, in the range studied, appeared to be small. Gage factors were determined by a static method with rapid unloading. Resistance instability (drift) was noted for both Alloys B and D when subjected to slow thermal cycles to 1600°F and cooled to room temperature. Also, both alloys showed a negative temperature coefficient of resistivity, in the temperature range 70 to 1800°F; Allpy D showed a value of -11.0×10^{-6}/°C and Alloy B -6.1×10^{-6}/°C. The magnitude of the temperature-induced drift in resistance was found to be a function of the wire size, being smallest for the largest wire size studied (0.002-inch diameter). Much lower rates of drift are exhibited at elevated temperatures. The rates between 1200 and 1600°F were roughly one tenth those at room temperature, but were still of a magnitude to preclude accurate static determinations. (auth)

25560 (NAMC-ASL-1050(Pt.III)) DEVELOPMENT OF BONDING METHODS AND MATERIALS FOR RESISTANCE STRAIN GAGES. H. L. Rechter (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 1958. Contract N156S-32317. 20p.

Work performed in formulating cements is reported. An attempt was made to develop a cement useful to temperatures of 1600°F and higher, having adequate electrical and load-bearing properties. Compositions of low alkaline colloidal silicas, aluminum phosphate, and silica fillers were found to provide excellent electrical properties to 1400°F with gages formed from Armour D alloy. Above this temperature, oxidation of the alloy interfered with gage readings, but the cements may be useful to higher temperatures with a suitable gage. Strain transmission, adherence, and thermal cycling properties were excellent. However, such cements must be cured similarly to Allen P-1 cement. Compositional studies resulted in formulations, with a potassium silicate binder, which can be cured at water drying temperatures, about 220°F, and provide excellent physical properties and fair electrical behavior. Moisture adsorption causes high electrical leakage at room temperature with the better experimental compositions. Silicone impregnations after each heating cycle provides an adequate moisture barrier. (auth)

25561 (NDL-TR-7) A BROAD RANGE CHEMICAL DOSIMETER FOR GAMMA RADIATION. Nathan Klein (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). July 1961. 36p.

A chemical dosimeter consisting of an air saturated, aqueous benzene solution is described. This rather simple system is capable of measuring gamma radiation dose in the range 20 r to 35,000 r. The radiation chemistry of the system is discussed briefly. (auth)

25562 (NP-11705) UN MISURATORE DI DISTRIBUZIONI DI FLUSSO NEUTRONICO. (A Neutron Flux Distribution Gage). F. Casali, U. Farinelli, and A. Pedrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratorio Fisica e Calcolo Reattori, Ispra). Apr. 1962. 35p.

A device that scans the activity of wires or plates irradiated in a reactor for studying neutron flux distribution is described. Emphasis was given to flexibility and complete automation of measuring cycles. The activity of Au, Cu, Co-Al-Mg, and Dy-Al alloy wires was measured by scintillation detectors. The resolution function was measured by a Au^{198} point source enclosed in a nonactivated Au wire. In measurements on critical or subcritical assemblies the symmetry of this function is more relevant than its shape or width. Epithermal contribution to the activation of Au wires was studied by using Cd cylinders shielding some parts of the wire during irradiation. (auth)

25563 (NP-11735) DEMOLTIPLICATORE DI IMPULSI TRANSISTORIZZATO A 10 Mc/s PRESELETTORE A NUCLEI DI FERRITE. (Transistorized Pulse Scaler at 10 Mc/s and a Ferrite Core Preselector Counting Circuit). A. Sanò and A. Serra (Italy. Comitato Nazionale per l'Energia Nuclear. Laboratorio di Elettronica, Rome). Apr. 1962. 17p. (RT/EL(62)3)

A transistorized pulse demultiplier, with a dead time better than 0.1 μs, which can work correctly up to 60°C, is described. The binary to decimal code conversion is obtained with a gate circuit. A ferrite core preselection circuit, derived by digital information, as in output from a ferrite core demultiplier, is also described. (auth)

25564 (NP-11822) OROLOGIO PROGRAMMATORE—A NUCLEI DI FERRITE. (Timer—Programmer with Ferrite Cores). F. Fioroni, A. Sanò, and A. Serra (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). May 1962. 19p.

A timer, particularly useful to drive counting equipment with automatic print of counted pulses is described. Counting times and intervals between measurements can be predetermined between 1 sec and 60 min. Ferrite cores scalers were used and the program was given by a three position commutation circuit built with cold-cathode Z70U tubes. (auth)

25565 (NP-11860) A FAMILY OF DIGITAL TRANSDUCERS. Myron L. Feistman and Paul Erskine Brown (Radio Corp. of America. Aerospace Communications and Controls Div., Camden, N. J.). [1962]. 29p.

The continuous electrical signals produced by most analog transducers measuring physical variables must be converted to digital form for use in areospace telemetry and display systems. The invariant radiation from a radionuclide is detected directly as discrete pulses. Transducers are described which alter the amount of radiation reaching the detector in proportion to a change in the physical variable measured. Changes in physical properties, such as density of fluids or gases directly alter the observed counting rate. Other transducers interpose a shaped absorber between the detector and source. Various radionuclide sources are discussed. The solid state diode detectors and their amplifying and counting circuits are described. Any desired digital code can be realized. (auth)

25566 (NP-11883) TRANSISTORIZED GENERATOR VOLTAGE CONTROL FOR A PRECISION, LARGE CURRENT MAGNET. Technical Report No. 42. J. C. Hafele and J. S. Allen (Illinois. Univ., Urbana. Nuclear Radiation Lab.). June 1962. Contract ONR 1834 (05). 14p.

A fully transistorized generator voltage control for a precision cyclotron magnet current regulator is described in detail. Need for an external power supply for the generator field current is eliminated by using self excitation. The control is stabilized by an auxiliary AC feedback loop. Variations in the generator output voltage are < 0.1 volt. With a slight modification the circuit can be used as a simple, versatile generator voltage regulator with about 0.1% regulation. (auth)

25567 (NP-11947) SOVIET NUCLEAR INSTRUMENTATION AND CONTROL FOR PROPULSION. Quarterly Report—AID Work Assignment No. 16c, Report No. 10 to June 1, 1962. (Library of Congress. Aerospace Information Div., Washington, D. C.). June 25, 1962. 21p.

Fifteen papers are reviewed from Soviet and Soviet-bloc developments in nuclear instrumentation and control for nuclear propulsion. Information is reported on the following topics: one paper on electronic equipment, nine on detectors, one on electromechanical control components, three on pneumatic control components, and one on a method for increasing the accuracy of various complex devices used for measuring time-variable physical quantities. (N.W.R.)

25568 (NYO-9644) ATOMIC ENERGY COMMISSION BLOOD CELL SCANNER. Second Technical Report. Report No. 5887. N. F. Izzo (Perkin-Elmer Corp., Norwalk, Conn.). Apr. 1, 1961. Contract AT(30-1)-2573. 63p.

The construction of an optical microscope vidicon television system is described. The television microscope and associated data processing system will be used for scanning blood smears to determine the feasibility of semiautomatic machine identification of binucleate lymphocytes. Analog/digital video conversion techniques are discussed. The special purpose computer's functions and design are described and the results of a preliminary study of a light source optical filter are included. (C.H.)

25569 (TID-15915) 12" SODIUM FLOW CONTROLLER. PERMANENT MAGNET COUPLING. MAGNETIC CALCULATION MANUFACTURE AND TEST RESULTS. Howard E. Flator (Westinghouse Electric Corp. Atomic Equipment Dept., Cheswick, Penna.). Aug. 18, 1961. Contract AT(11-1)-681. 45p.

In order to retain the hermetic feature of the sodium flow controller, magnetic flux linkage of a permanent magnet coupling is used to transmit the torque produced by the operator through the pressure wall. Magnetic calculations, manufacture, and testing of this magnet coupling are described. (M.C.G.)

25570 (TID-16107) AN INVESTIGATION OF SCINTILLATION CRYSTALS FOR NEUTRON DOSIMETRY (thesis). Charles Edward Norelius (Washington. Univ., Seattle). 1962. 3p.

Research was carried out on a scintillation crystal whose response would match the dose curve for neutrons over a wide range of energies. The selection of materials, the mixture of these which give the best results, the method of crystal construction, and the data obtained from these crystals are discussed. A crystal of ZnS(Ag) and lucite in a ratio of 1 : 4 gave the best response. (M.C.G.)

25571 (TID-16268) A SYSTEM FOR THE SIMULTANEOUS DETECTION OF TWENTY POSITRON-EMITTING SOURCES. F. C. Jobes, J. A. McIntyre, and L. C. Becker (Yale Univ., New Haven.) [July 5, 1962]. Contract [AT (30-1)-2726]. 32p.

A detection system was constructed for counting simultaneously the positrons emitted from twenty radioactive sources. The system features high efficiency of detection (20%), low background (⅓ counts per minute), insensitivity to source thickness and geometry, and complete discrimination against beta-decay electrons and gamma rays not emitted in cascade. (auth)

25572 (USNRDL-TR-567) RESPONSE REQUIREMENTS FOR MILITARY RADIACS. 3. APPLICATION OF A RELIABILITY PREDICTION TECHNIQUE TO A NAVY RADIAC. J. A. Kunzman and H. R. Wasson (Naval Radiological Defense Lab., San Francisco). June 11, 1962. 60p.

An established reliability prediction technique (NAVSHIPS 900-193, TR1100) was applied to a portable radiac, the AN/PDR-27(J). This theoretical analysis yielded a probable Mean-Time-Between-Failures (MTBF) of 5056 hr with an uncertainty of ±40 percent. A debugging period of 160 hr was also predicted. The theoretical analysis was confirmed by a laboratory test of 100 instruments operating for 1000 hr. An exponential life curve was demonstrated with an MTBF of approximately 7000 hr. The range for a 90 percent confidence level was from 4,840 to 12,250 hr. The empirical debugging period was about 98 hr. Conclusions are drawn concerning the utility of applying this type of reliability analysis to small portable radiac devices. (auth)

25573 (WCAP-1989) DEVELOPMENT OF MINIATURE SiC NEUTRON DETECTORS. Quarterly Progress Report for Period January 1, 1962 to March 31, 1962. J. Weisman, ed. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Apr. 1962. Contract AT(30-1)-2827. 26p.

The development and evaluation of miniature silicon carbide neutron detectors are given. Surface junction diodes capable of counting α particles were produced, and the ability to count at temperatures up to 700°C was demonstrated. (P.C.H.)

25574 (AEC-tr-5193) PHOTOGRAPHIC FILM-PLATE FOR THE EXACT MEASURE OF THE QUANTITY OR DOSE OF HIGH ENERGY RADIATION. K. Becker, E. Zeitler, and E. Klein. Translated by Myra S. Feldman (Savannah River Lab., Aiken, S. C.) from French Patent 1,242,907. Aug. 29, 1959. 2p.

A packet of photographic films is described that was designed to measure exactly the quantity or dose of high energy radiation. The packet contains one or more layers or sheets of a reflective metallic foil in direct contact with a film layer on one or two sides of a silver halide emulsion containing fluorescent substances, so that, on each side, there is a metallic layer which favorably influences the electronic equilibrium, as well as one or more wrappings of paper or opaque plastic material. (auth)

25575 (AEC-tr-5239) CHARACTERISTICS OF SPARK COUNTERS WITH PLANE-PARALLEL ELECTRODES. Yu. F. Skachkov. Translated by Helen Basil (Argonne National Lab., Ill.) from Pribory i Tekh. Ekspt., 6: No. 6, 41-4(Nov.-Dec. 1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11902.

25576 (FTD-TT-62-369) A MASS-SPECTROMETER. A. S. Bryukhanov, V. N. Golub', and A. G. Chenkanov. Translated from U.S.S.R. Patent No. 139478. Nov. 24, 1960. 6p.

A mass spectrometer was designed in which the drift space is enlarged by repeated reflection of the ion beam using electrostatic mirrors. The mirrors consist of a metal grid and a reflector in parallel planes and enclosed in a metal shield making it possible to eliminate electrostatic fields outside the mirror. These mirrors increased the resolution of the mass spectrometer. (M.C.G.)

25577 (NP-tr-902) THE EXTRACTION SYSTEM OF ION SOURCES OPERATED AT RADIOFREQUENCIES. Gyula Páris. Translated by T. P. Bor (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Magyar Tudományos Akad. Központi Fiz. Kutató Intézetenek Közleményei, 9: 57-62(1961). 13p. (Includes original, 4p.).

In elaborating the design principles of extracting systems for ion sources operated at radiofrequencies, the system is shown to be similar in many respects to the Pierce type electron-gun. Dimensions within which the extraction system can be satisfactorily operated are determined. These principles of design are of particular importance for high current and pulsed ion sources. The results are in good agreement with the experimental data. (auth)

25578 THE MEMORY OF RADIOISOTOPE THICKNESS GAGES. J. Guizerix. Automazione e strumentazione, 9: 77-80(1961). (In Italian)

Parameters affecting the memory of radioisotope thickness gages are discussed, and the calibrations necessary to compensate for them are described. Brief descriptions are given of three thickness gages using scintillation detectors. (J.S.R.)

25579 THE EFFECT OF SCINTILLATION IN VALVE AUTO-OSCILLATORS. Augustin Blaquière. Compt. rend., 252: 2390-2(Apr. 17, 1961). (CEA-2028) (In French)

The possible sources of fluctuations in a valve auto-oscillator having an oscillating circuit connected to the grid were analyzed. The shot-noise of the valve was introduced into the theory by including in the grid circuit an imaginary resistance. The effect of the abnormal background noise of the valve in the low frequency domain (scintillation effect) on the normal working of the auto-oscillator is described. A delicate point is thus resolved, in a region of the spectrum having a great importance in hertzian spectrometry. (auth)

25580 AN ANASTIGMATIC ALINEMENT SYSTEM BY DOUBLE MAGNETIC DEFLECTORS WITH STIGMATOR IN THE ELECTRON BEAM INSTRUMENTS. Koichi Kanaya (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 26: 161-72(1962). (In English)

An improved electron-beam shift and tilt system consisting of double magnetic deflectors with the stigmator used in correcting of illuminating beam is designed to replace normal mechanical alinement systems. This improves the mechanical stability of the illuminating system, provides more convenient alinement controls, and compensates the astigmatism due to misalinements of the illuminating beam without moving the heavy illuminating system. (auth)

25581 DESIGNING AVALANCHE SWITCHING CIRCUITS. Richard P. Rufer (Univ. of California, Livermore). Electronics, 34: 81-7(Apr. 1961). UCRL-6012-T(Rev. 1))

The use of transistors as high speed switches in avalanche mode circuits was reported previously, but the application of these circuits has been limited by the relatively low output powers available with the use of Ge transistors. The advent of Si mesa units, with their higher power and voltage ratings, has increased the capabilities of avalanche mode switching circuitry so that such circuits are now advantageous for high speed, high power pulse generating applications. The important considerations for design of such circuits are described and explained in detail. (auth)

25582 APPARATUS OF THE MEASUREMENT OF THE ELECTRICAL RESISTANCE OF INSULATORS DURING REACTOR IRRADIATION. L. Heyne and H. Hoefgen (Zentralinstitut fur Kernphysik, Dresden). Expti. Tech. Physik, 10: 32-40(1961). (In German)

A device for measuring the specific electrical resistance of insulators during reactor irradiation is described. The upper measurement limit is 10^{19} ohm cm, and the measurement accuracy is ±6%. The device is provided with a programed control and records the resistance pattern continu-

ously. Preliminary results of measurements on polystyrol are reported. (tr-auth)

25583 A SIMPLE METHOD FOR THE AUTOMATIC RECORDING OF PULSE HEIGHT DISTRIBUTION. K. H. Krebs (Kernphysikalisches Institut der Deutschen Akademie der Wissenschaften, Berlin). Exptl. Tech. Physik, 10: 59-62(1962). (In German)

A simple method is described that permits, with a single-channel discriminator and electronic compensation recorder, a pulse-height distribution to be automatically recorded in several minutes. Spectra taken with this method illustrate the results obtainable. (tr-auth)

25584 SIMPLE COUNTER ARRANGEMENTS FOR WEAK ACTIVITIES. H. Seidler and M. Haertig (Institut fur Ernahrung, Bereich Verarbeitung der Lebensmittel, Potsdam, Ger.). Isotopentechnik, 3: 80(Mar. 1962). (In German)

The combination of two end-window counters and the advantages thereby obtained in the measurement in low activity are explained. The carrier preparation necessary for this device and the universally applicable suction device used with it are described. (tr-auth)

25585 SEMICONDUCTOR NUCLEAR SPECTROMETERS. Tibor Fényes. Magyar Tudományos Akad. Atommag Kutató Intezéte (Debrecen). Közlemények, 3: 43-54(Apr. 1961). (In Hungarian)

25586 MEASUREMENTS OF NEUTRON SPECTRA WITH A FAST CHOPPER. Erik Johansson and Erik Jonsson (AB Atomenergi, Stockholm). Nuclear Sci. and Eng., 13: 264-70(July 1962).

Spectra of neutrons scattered from various materials placed in the central vertical channel of the reactor R1 are studied. Interest is given to the epithermal region, in particular to the distortion of the spectrum caused by the fuel. For scatterers with heavy atoms it is thus possible to observe "steps" in $E \cdot \Phi(E)$ at each of the three lowest uranium resonances. The heights of these steps compare favorably with calculations. The upper energy limit for the measurements made is about 10,000 ev. Some experiments using a heated scatterer are also performed. (auth)

25587 FREQUENCY RESPONSE OF CURRENT ION CHAMBER. R. Subramaniam and R. Vedam (India Atomic Energy Establishment, Trombay). Nuclear Sci. and Eng., 13: 271-4(July 1962).

The frequency response of a neutron-sensitive current ion chamber is determined by beam modulation. The response is shown to be adequately explained by the transit time of heavy ions, provided effective attachment of electrons is included in the consideration. (auth)

25588 INSTRUMENTATION FOR SPACE RESEARCH. D. Brini, U. Ciriegi, A. Gandolfi, and G. L. Tabellini (C.N.R., Bologna and Universitá, Bologna). Nuovo cimento (10), 22: Suppl. No. 2, 545-89(1961). (In English)

The basic prerequisites that instrumentation for space research must satisfy are discussed. The instrument properties discussed are weight and volume, reliability, versatility, accuracy, data processing, data storage capability, information efficiency, telemetering system range, transmission band width, and telecontrol capability. The basic circuits for a number of instruments are given. (J.S.R.)

25589 APPLICATION OF SILICON DETECTORS TO MEASUREMENTS OF MONOENERGETIC NEUTRON BEAMS. M. G. Marcazzan, F. Merzari, and F. Tonolini (Laboratori CISE, Milan). Phys. Letters, 1: 21-1(Apr. 1, 1962). (In English)

A method is described, utilizing a Si detector, for measuring the energy and line width of monoenergetic neutron beams at 6.8 to 18 Mev. The method consists in the measurement of the total kinetic energy (T) of the α particle and ground-state Mg^{25} nucleus formed in the reaction $Si^{28}(n,\alpha)Mg^{25}$ in the detector. Both the products are detected with equal efficiency. The α particles leading to the Mg^{25} ground state have a well-defined line with a width of about 40 to 100 kev. The Q-value for the reaction (2.66 Mev) plus T equals the neutron energy, and the neutron line width can be determined from the Mg^{25}-ground-state α-particle line width. (T.F.H.)

25590 SUPERCONDUCTING NUCLEAR PARTICLE DETECTOR. N. K. Sherman (Queen's Univ., Kingston, Ont.). Phys. Rev. Letters, 8: 438-9(June 1, 1962).

An ionizing-radiation detector consisting of a superconducting film about 1000 Å thick in series with a normal-state small resistance is described. A particle traversing the film produces a plasma of nonsuperconducting nature with a radius on the order of 200 to 40,000 Å, and this nonsuperconducting plasma causes a pulsed decrease in the current flowing in the circuit. The detector is capable of discriminating between various types of charged particles. A Sn film is considered as an example at 3°K, in series with a 10-ohm resistor carrying a current of 5 ma. Alpha particles passing through the film transversely at 5 Mev produce a normal volume with a radius of 1500 Å and a voltage pulse of about 1 mv; a 30-Mev fission fragment produces a normal volume with a radius of 40,000 Å and a voltage pulse of about 4 mv. (T.F.H.)

25591 PULSE INTEGRATORS FOR NUCLEAR RADIATION TESTS. Ryszard Jakubowski and Jan Porebski. Poimiary, Automatyka, Kontrola, 6: 140-2(1960).

Three types of linear pulse integrators, which are employed in industrial and geological isotope research are described. The characteristics and properties of each instrument, and the circuit diagrams are given. (OID)

25592 EXTERNALLY QUENCHED HYDROGEN COUNTER FOR TRITIUM MEASUREMENT AND ITS APPLICATION TO ABSOLUTE ASSAY OF TRITIATED WATER. Yung-ho Kang, Tan Takahashi, and Tatsuji Hamada. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 56: 51-8(Mar. 1962). (In English)

Glass-walled cylindrical counters having evaporated gold cathodes and filled with hydrogen up to 1 atm were operated with external quench and proved to have satisfactory characteristics with plateaus of 200 to 250 v in length and slope of less than 1% per 100 v. The length of quench pulses of 250 v in amplitude required for good counter performance was found to depend on the size of the counter tube, i.e. about 320 μsec for counters of up to 135 mm in length and 23 mm in internal diameter, and somewhat longer for longer tubes of the same diameter. Three such counters of the same construction but of different lengths were used for absolute assay of tritiated water. The procedure of reduction of water samples with metallic calcium and zinc was described. (auth)

25593 A SMALL NEUTRON DIFFRACTOMETER. I. I. Yamzin, V. E. Staritsyn, and Yu. Z. Nozik (Inst. of Crystallography, Academy of Sciences, USSR). Soviet Phys.-Cryst., 7: No. 1, 58-61(July-Aug. 1962). (In English)

A small neutron diffractometer, for use with monocrystalline and polycrystalline samples, is described. (auth)

25594 MEASUREMENT OF NEUTRON FLUX AND SPECTRA FOR PHYSICAL AND BIOLOGICAL APPLICATIONS. Recommendations of the U. S. National Committee

on Radiation Protection and Measurements. National Bureau of Standards Handbook 72. 1960. 98p. $0.35(GPO)

The measurement of neutron flux and spectra is discussed, methods are compared, and results of intercomparisons are given. Methods of measurement are discussed for the emission rate of radioactive neutron sources, thermal neutron flux, intermediate neutron flux, fast neutron flux, and neutron energy spectra. Neutron radiation instruments for area survey and personnel monitoring involving flux and spectrum measurements are included. Typical spectra of neutron sources are shown. (auth)

25595 RADIOMETRIC STANDARDS AND MEASUREMENTS. Notes on Applied Science No. 23. E. J. Gillham (Gt. Brit. National Physical Lab., Teddington, Middx., England). 1961. 27p. $0.25(BIS).

Methods used at the National Physical Laboratory for the measurement of ultraviolet, visible, and infrared radiation are described. Instruments for measuring total radiation are included. (C.H.)

25596 IMPROVEMENTS RELATING TO APPARATUS FOR DETECTING RADIOACTIVITY IN A FLUID. Douglas Richard Chick, Simon Edward Rippon, Kenneth Firth, and Alan James Salmon (to Associated Electrical Industries Ltd.). British Patent 901,651. July 25, 1962.

A Cherenkov detector apparatus is designed for monitoring the power of a reactor having water coolant or high pressure gas coolant. The apparatus comprises a ducting for carrying the coolant to the detector and a photoelectric device for measuring the Cherenkov radiation. In the case of water coolant, most of the radioactivity is due to N^{16}, and the detection circuit can be set to detect only fission products and N^{16}. (D.L.C.)

25597 IMPROVEMENTS RELATING TO APPARATUS FOR MEASURING RADIATION PRODUCED IN NUCLEAR REACTORS. Alan James Salmon (to Associated Electrical Industries Ltd.). British Patent 901,652. July 25, 1962.

A Cherenkov detector apparatus is designed for monitoring the power of a water-cooled reactor. The apparatus is positioned within the reactor to detect Cherenkov radiation from the core, and it may be made to be sensitive only to the uv portion. (D.L.C.)

25598 IMPROVEMENTS RELATING TO APPARATUS FOR DETECTING RADIOACTIVITY IN A FLUID. Douglas Richard Chick, Kenneth Firth, Simon Edward Rippon, and Alan James Salmon (to Associated Electrical Industries Ltd.). British Patent 901,661. July 25, 1962.

A Cherenkov detector apparatus is designed for detecting fission products in a reactor coolant, e.g., liquid or high-pressure gases. The coolant is caused to flow through a sampling circuit with a flow delay means whereby only the longer lived fission products and not N^{16} are detected. (D.L.C.)

25599 IMPROVEMENTS IN OR RELATING TO THERMOCOUPLE CABLES. Gideon Sorsky and Frederick Alan Cusworth (to British Insulated Callender's Cables Ltd.). British Patent 901,884. July 25, 1962.

A thermocouple cable is designed to break when subjected to a predetermined load less than the breaking of the cable, for use with fuel cans in a reactor. The cable has a loop secured with a wire or shear pins which will fail upon application of the predetermined load, in which case the loop will form a kink and break. (D.L.C.)

25600 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS. Allan Norman Hamer and Colin Campbell McCormick (to United Kingdom Atomic Energy Authority). British Patent 902,166. July 25, 1962.

A mass spectrometer is designed for use with gaseous samples, e.g., UF_6. In the spectrometer, the pipe for introducing a gaseous sample has its sample discharge end formed of ceramic material and spaced from the ion source to minimize the memory effect. The orifice is larger than the pipe bore so that substantially all the sample passes through the orifice. (D.L.C.)

25601 DIRECT COUPLED PROGRESSIVE STAGE PULSE COUNTER APPARATUS. William M. Kaufman (to U. S. Atomic Energy Commission). U. S. Patent 3,049,628. Aug. 14, 1962.

A progressive electrical pulse counter circuit was designed for the counting of a chain of input pulses of random width and/or frequency. The circuit employs an odd and even pulse input line alternately connected to a series of directly connected bistable counting stages. Each bistable stage has two d-c operative states which stage, when in its initial state, prevents the next succeeding stage from changing its condition when the latter stage is pulsed. Since only alternate stages are pulsed for each incoming pulse, only one stage will change its state for each input pulse thereby providing progressive stage by stage counting. (AEC)

25602 QUICK DISCONNECT ELECTRICAL CONNECTOR. (to U. S. Atomic Energy Commission). U. S. Patent 3,049,690. Aug. 14, 1962.

A remotely actuated quick-disconnect electrical connector which comprises a pair of mating portions releasably retained together by a bayonet-type joint with a rotatable sleeve on one of the mating portions providing for engagement and disengagement of the joint is described. A lanyard with ends passed through fulcrums and affixed to the sleeve effects rotation of the sleeve and disengages the joint. (AEC)

25603 RENEWABLE LIQUID GETTERING PUMP. Thomas H. Batzer (to U. S. Atomic Energy Commission). U. S. Patent 3,050,236. Aug. 21, 1962.

A method and structure were developed for pumping gases by simple absorption into a liquid gettering material. The invention comprises means for continuously pumping a liquid gettering material from a reservoir to the top of a generally vertical surface disposed in a vacuum pumping chamber to receive gaseous and other particles in the liquid gettering material which continuously flows downward over the vertical surface. Means are provided for continuous removal, degassing, and return of a portion of the liquid gettering material from the reservoir connected with collecting means at the base of the generally vertical plate. (AEC)

Materials Testing

25604 (BNL-716) BIBLIOGRAPHY ON GAMMA-RAY RADIOGRAPHY 1950 TO 1961 INCLUSIVE, WITH SUBJECT AND AUTHOR INDICES. Jere C. Austin (Brookhaven National Lab., Upton, N. Y.). Mar. 1962. Contract [AT(30-2)-GEN-16]. 22p.

References (292) are given to reports, journals, and patents published from 1950 to 1961. An attempt was made to separate material on gamma radiography from that on x radiography and nondestructive testing in general. Titles are listed by year of original publication. Separate author and subject indexes are included. (P.C.H.)

25605 (DC-55-11-47) NUCLEAR POWER SIMULATION IN CONCENTRIC ELEMENTS BY INDUCTION HEATING. General Engineering Development Report No. 135. Alfred Miles (General Electric Co. Aircraft Nuclear

Propulsion Dept., Cincinnati). Nov. 7, 1955. Contract AT(11-1)-171. 38p.

An experimental investigation was made of solid moderator type, metallic ribbon fuel elements which were heated inductively at 3000 cycles per second to simulate the power generation of nuclear heating. A major deviation from normal induction heating procedures was used when a laminated iron core (of high magnetic permeability) was inserted in the center of the test specimens. The relative power densities obtained in heating two types of elements (4-ribbon concentric ring and 4-ribbon concentric hexagon) to power densities as high as 5 kilowatts per cubic centimeter are presented graphically. By using the proper amount of iron core, the power density in four ribbons could be made nearly uniform. (auth)

25606 (TID-15356) A REVIEW OF EQUIPMENT HAVING CAPABILITIES FOR LOW CYCLE FATIGUE TESTS. Interim Technical Report No. 2. A. P. Taber and W. W. Gerberich (Syracuse Univ., N. Y. Metallurgical Research Labs.). Sept. 19, 1958. Contract AT(30-1)-2141. 42p. (MET575-5891T2).

Some of the methods and equipment now in use or having capabilities for use in low-cycle fatigue tests are described. The survey covers primarily recently developed fatigue testing equipment and uses schematic sketches to describe some of the more complicated apparatus. (auth)

25607 LOW CYCLE FATIGUE RESEARCH ON FULL-SIZE PRESSURE VESSELS. L. F. Kooistra (Babcock and Wilcox Co., Alliance, Ohio) and M. M. Lemcoe. Welding J., (N. Y.), 41: 297s-306s(July 1962).

The results of an experimental study to determine the low-cycle fatigue characteristics of full-size pressure vessels incorporating a variety of nozzle configurations of interest to the reactor designer and pressure vessel industry at large are discussed. Numerical data on stress and strain concentration factors, redistribution of strains upon cycling, and a description of cyclic test facilities are also included. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

25608 (AD-265437) SOVIET SEISMOLOGY AND SEISMOMETRY. A Preliminary Bibliography. (Library of Congress. Air Information Div., Washington, D. C.). Sept. 5, 1961. 77p. (AID-Report-61-135)

This preliminary bibliography on seismology and seismometry is primarily limited to the years of 1958, 1959, and 1960. Not all of the ramifications of this science are presented, but this bibliography may serve as a guide to the growing volume of Soviet seismological literature. The listing of the entries is divided for convenience into 13 main subject headings with appropriate subheadings. Library of Congress call numbers are included at the end of the entries when the source is cataloged and available in its collections. (C.H.)

25609 (AFCRL-62-299) IDENTIFICATION OF STRATOSPHERIC AEROSOLS. Final Report. S. Schur and R. E. Ogilvie (Advanced Metals Research Crop., Somerville, Mass.). Jan. 31, 1962. Contract AF19(604)-7498. 56p. (AMR-1134)

The composition of stratospheric aerosol collections was determined using electron beam microanalysis. Dense sub-micron particle deposits as well as individual particles of the order of 2 to 20 microns were analyzed. The microanalyzer used for the collections is in principle, a finely focussed x-ray tube with the sample being analyzed as the target anode. A defocussed beam of about 70μ was generally used in order to obtain a good statistical sampling for calculating surface density of the elements present. Analyses were conducted in the range of elements from Mg through Zn and were generally performed by driving the sample under the electron beam so that traverses down the center of the length of the sample were described. Calibration studies were performed to relate the observed x-ray intensity to the surface density of the deposited material. The relation between electron beam size and a determination of the number of larger particles present was also made. The major constituent of the collection in the range of elements investigated was found to be sulfur, probably present as a sulfate. Silicon, iron, and aluminum were also present in smaller, but still significant amounts. (auth)

25610 (AFCRL-863) INITIAL STUDIES ON UNDERGROUND NUCLEAR DETECTION WITH SEISMIC DATA PREPARED BY A NOVEL DIGITIZATION SYSTEM. Scientific Report No. 1. S. M. Simpson, Jr. (Massachusetts Inst. of Tech., Cambridge). June 30, 1961. Contract AF19(604)-7378. 545p. (AD-271184)

A semi-automatic paper record digitization system, developed by the project was applied to a number of seismic records resulting from the Logan and Blanca nuclear shots. Data for 27 records digitized at $\frac{1}{50}$ sec increments and for 34 earthquake records adapted from digitizations of Bruce Bogert are presented. Rough measures of microseismic noise amplitude showed inverse correlation with distance from nearest ocean. Two spectral estimations near the coast showed narrow lines at 1, 1.4, and about 2.9 cps in the vertical whereas at a three component inland station the noise was primarily concentrated below 1 cps, with small peaks at higher frequencies appearing on the horizontals only, suggestive of Love waves. A test for the presence of Rayleigh waves on this three component record, narrow band filtered at $\frac{1}{4}$ cps failed to show any, a possible explanation being barometric coupling to the vertical instrument. (auth)

25611 (BNL-718) A STUDY OF THE WIND PROFILE IN THE LOWEST 400 FEET OF THE ATMOSPHERE. Final Report. Irving A. Singer and Constance M. Nagle (Brookhaven National Lab., Upton, N. Y.). Mar. 31, 1962. Contract [AT(30-2)-Gen-16]. 35p.

This report summarizes all phases of a detailed study of the predictability of the scalar horizontal wind speed at an upper elevation from wind data obtained at lower reference heights over varying averaging lengths. To study this predictability, several mathematical models were developed. The first, or simple, model was achieved by multiplying the reference speed by a constant to obtain the corresponding average at the higher elevation. This form was suggested by the power law describing the variation of the mean wind speed with height. The simple model, which employs spectral and cross-spectral computation, was used to evaluate the mean square error over various averaging lengths. The second or mean model has the same general form as the first, but the mean value of the wind speed at all levels is subtracted from the actual wind speed prior to computation of the mean square error. The final model produces the best possible predictor using linear methods. This best possible model, although not applicable under actual conditions, provides a benchmark with which the mean square errors from other linear models can be compared. Such comparison clearly indicates that the mean model is an excellent approximation to the best possible. To evaluate the effect of time and space displacement of the reference level, a wind instrument on a portable 50-ft mast was placed at several locations, at each of which several runs were completed. The error analysis for all three models indicated that Taylor's hypothesis can be used to reduce the error caused by displacing the reference instrument. To ensure wind data of sufficient accuracy for evaluation of the models, a rigorous calibration procedure was developed. In addition, a special data reduction system was used to facilitate recording and processing of the data. (auth)

25612 (HW-71400(Vol.I)) THE GREEN GLOW DIFFUSION PROGRAM. VOLUME I. Geophysical Research Papers No. 73. Morton L. Barad and James J. Fuquay, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash. and Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). Jan. 1962. Contract AT(45-1)-1350. 89p. (AFCRL-62-251(I))

The GREEN GLOW program was a field investigation aimed at providing experimental data on the diffusion of an aerosol over a 16-mile range. The experiments, 26 in number and all during nighttime hours, were conducted on the Hanford reservation of the U. S. Atomic Energy Commission, near Richland, Washington during the Summer of 1959. Descriptions of the field site, forecasting techniques, diffusion-measuring methods, meteorological equipment, and operating procedures during the experiments are discussed. (auth)

25613 (HW-73711) ELECTRICAL ANALOG SIMULATION OF HANFORD GROUND WATER FLOW. R. W. Nelson and W. A. Haney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1962. Contract AT(45-1)-1350. 17p.

Applications are described of three-dimensional electrical analog simulation in studies of the Hanford ground water flow regime. It is postulated that the electrical

analog will be the basic tool for solving many practical plant problems and will also be applied in other fields of scientific hydrology. (C.H.)

25614 (JPL-TR-32-147) COSMIC RADIATION AND THE $K^{40}-A^{40}$ "AGES" OF IRON METEORITES. R. R. Marshall (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Aug. 10, 1961. Contract NASw-6. 14p. (AD-271649).

The potassium–argon data of Stoenner and Zachringer are consistent with an age for the iron meteorites of 5.0 ± 0.5 aeons. For iron meteorites with moderate to high concentrations of He-3, the Ar^{40} which has been produced by nuclear spallation and the Ar^{40} produced by the decay of primordial K-40 can be calculated accurately (provided that the radiation age of the meteorite is known) and their sum compared to the measured Ar^{40}. Cosmogenic neon and argon predominate in inclusions of troilite and schreibersite in large ion meteorites. The enhanced yield of these elements seems to be due to the interaction of cosmic rays with elements below iron in atomic mass, such as chlorine, sulfur, and phosphorus. The K-39/K-41 ratio of some potassium recovered from the Canyon Diablo iron meteorite differed by less than 2% from the ratio in terrestrial potassium, but was consistent with the low radiation age of 0.145 aeon calculated by Fisher and Schaeffer for this meteorite. (auth)

25615 (NP-11760) METEOROLOGICAL ASPECTS OF THE PEACEFUL USES OF ATOMIC ENERGY. PART I. METEOROLOGICAL ASPECTS OF THE SAFETY AND LOCATION OF REACTOR PLANTS. Technical Note No. 33. P. -J. Meade (World Meteorological Organization, Geneva). 1960. 40p.

The aspects examined include the interpretation of radioactivity measurements obtained in routine monitoring, the special considerations which arise when a sudden, accidental release of radioactivity takes place, and the allowance to be made in estimates of concentration when there is deposition on the ground or vegetation. A discussion of practical meteorological problems involved in locating reactor plants is included. (J.R.D.)

25616 (NP-11914) RADIOACTIVE FALLOUT MONITORING PROGRAM. Quarterly Report, January–March 1962. (Canada. Dept. of National Health and Welfare. Radiation Protection Div., Ottawa). July 1962. 38p.

Data on radioactive fall-out in air, ground-level air, rainfall, and ground, and Sr^{90} content in milk in various cities in Canada during the first quarter of 1962 are tabulated. (P.C.H.)

25617 (TID-3086(Suppl.1)) RADIOACTIVE FALLOUT. A Bibliography of the World's Literature. William E. Bost, comp. (Division of Technical Information Extension, AEC). Feb. 1962. 224p.

References (1525) on radioactive materials produced by nuclear explosions are given to reports and journals published from October 1960 to February 1962. Emphasis is placed on the interaction of radioactive materials with the biosphere and with its inhabiting organisms, but an attempt was also made to cover contiguous areas. Separate author and report availability indexes are included. (P.C.H.)

25618 (TID-15225) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Quarterly Progress Report, December 1, 1961 through February 28, 1962. (Rice Univ., Houston, Tex.). For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], Subcontract 1491. 34p.

A generalized geologic map, together with radiometric stations, is presented for New Hampshire. A statistical analysis of data on the main mass of Conway granite indicates that the thorium concentration is lognormally distributed and that additional stations on the surface are of doubtful value. The over-all average of 175 counts per minute remains unchanged, but a refined calibration of the field instrument raises the thorium reserve estimates by 12%. Autoradiographs examined to data indicate that thorium and uranium are largely localized in hot grains enclosed in biotite. (auth)

25619 (TID-16272) AN INVESTIGATION OF TRITIUM IN ATMOSPHERIC MOISTURE, RAINWATER AND THE SEA IN THE EUROPEAN AREA. Annual Progress Report, July 1, 1961–June 30, 1962, and Renewal Proposal. Bert Bolin (Stockholm. Univ.). Contract AT(30-1)-2458. 13p.

Data are tabulated on the tritium content of samples of atmospheric moisture, rain water, and sea water collected in Sweden, Norway, Ireland, and Iceland between 1957 and April 1962. (C.H.)

25620 INSTITUTE OF NUCLEAR RESEARCH, POLISH ACADEMY OF SCIENCES — RESULTS OF MEASUREMENTS OF THE RADIOACTIVITY OF AIR CONTAMINANTS AND ATMOSPHERIC PRECIPITATION IN CRACOW FOR JANUARY TO MARCH 1960. J. Jurkiewicz and M. Massalska. Acta Geophysica Polonica, 8: 379(1960).

Results are presented for total fall-out and precipitation radioactivity in Cracow, Poland, during the first three months of 1960. (N.W.R.)

25621 DETERMINATION OF THE CONCENTRATION OF HEAVY WATER IN THE NATURAL WATERS OF CHILE. Ia. WATERS OF THE REGION OF CONCEPCIÓN. César Fighetti, Gotardo Schenkel, and Sergio Droguett (Universidad de Concepción, Chile). Bol. Soc. Chilena Quim., 10: 1-5(Dec. 1960). (In Spanish)

The concentration of heavy water in natural waters of the region of Concepción (Chile) was measured using the float method. It is found that all the samples studied have a normal content of heavy water. (auth)

25622 INTERRELATION BETWEEN COLORATION, ABSORPTION SPECTRAE AND RADIOACTIVITIES OF FLUORITES FROM DIVERSE LOCALITIES. G. Mueller, W. Recke, and R. Vera Mege (Universidad Concepción, Chile). Bol. Soc. Chilena Quim., 11: 8-12(Dec. 1961). (In English)

Seventy-eight fluorite specimens originating from major localities were analyzed for U-equivalent of radioactivity up to ±1 ppm accuracies through β and γ counts. It was found that the radioactivity increases from 1 to 3 ppm U-equivalent for colorless finely ground powders to around 100 ppm with the darkening of the blue-purple coloration. The curves constructed between radioactivity and certain characteristic wave lengths of the absorption spectra clearly indicate the quantitative or quasi-quantitative nature of this relation. The coloration is explained through gradual accumulation of Ca-colloids through development of lattice imperfections within the CaF_2 lattice as a result of bombardment by radioactive projectiles. For this reason, very dark fluorites also contain detectable free F_2. The steel blue coloration provoked through x rays or intensive radiation is less stable than the natural one. The close succession of sharply defined purple and blue zones suggest α activity, in which only some types of fluorites with presumed imperfections in the lattice are adapted to accomodate the larger sized calcium colloids. From microscopic and chemical studies of colored halos surrounding bitumen inclusions, it appears that in certain specimens at least, the U and minor

Th are carried into the lattice through finely divided carbonaceous substances, of aromatic, but that the latter are not primary causes of the coloration. (auth)

25623 ABUNDANCES OF IODINE, TELLURIUM AND URANIUM IN METEORITES. G. G. Goles (Univ. of California, La Jolla) and E. Anders. Geochim. et Cosmochim. Acta, 26: 723-37(July 1962). (In English)

Neutron activation analysis was employed to determine the abundances of I, Te, and U in seven bronzite and hypersthene chondrites, three enstatite chondrites, and two carbonaceous chondrites. On the basis of twenty-three analyses, the mean abundances in ppm for the three groups were: iodine, 0.040, 0.17, and 0.27; tellurium, 0.51, 2.1, and 1.9; uranium, 0.013, 0.011, and 0.017. In meteoritic iron (four analyses), these abundances covered a wider range, i.e., 11 to 320, 17 to 90, and <0.15 to <0.6 ppb, whereas five analyses of troilite gave 24 to 3600, 1200 to 5000 and 3.5 to 17 ppb. These data indicate that Te, and to a lesser extent I, are chalcophile in iron meteorites. In chondrites, I and Te are strongly correlated, and appear to reside in the same phase, tentatively identified as CaS or MgS. Four of the meteorites in the present study were previously analyzed by von Fellenberg. His values are found to be uniformly too high by factors of 5 to 30. It seems likely that most of the data in his fundamental study of the geochemistry of iodine are systematically too high by comparable factors. (auth)

25624 RADON AND RADIUM CONTENT OF SOME ISRAELI WATER SOURCES AND A HYPOTHESIS ON UNDERGROUND RESERVOIRS OF BRINES, OILS AND GASES IN THE RIFT VALLEY. E. Mazor (Israel Atomic Energy Commission, Tel-Aviv). Geochim. et Cosmochim. Acta, 26: 765-86(July 1962). (In English)

In a survey of the radon and radium contents of various water sources in Israel, a number of anomalies were detected. All the highest values found were in waters located in the Jordan Rift Valley, which is a part of the large Syrian-African Rift Valley. To explain these anomalies and other geochemical features of these sources a hypothesis of underground reservoirs of brines, oils, and gases was developed. Field data appear to indicate the existence of such reservoirs in the Dead Sea and Lake Kinneret areas, where they seem to be the source of the mineral and radioactive springs occurring on the shores. The results lead to some practical conclusions concerning the possible exploitation of potassium-rich brines found near the Dead Sea, the salinization of Lake Kinneret, and prospecting for oil and gas in the Rift Valley. (auth)

25625 RECORDING OF POTENTIAL GRADIENTS, MEASUREMENT OF POLAR ELECTRICAL CONDUCTIVITY OF AIR, AND ALSO THE RELATIVE AIR RADIOACTIVITY AND DETERMINATION OF NO_2 CONTENT OF PRECIPITATION AND CLOUDS ON THE ZUGSPITZPLATT (2580 m NN) IN SUMMER 1955. Reinhold Reiter. Geofis. pura e appl., 33: 187-222(1956). (In German)

The results of a study at the Zugspitzplatt (2580 m NN; Wetterstein Mountains, Northern Alps) from August 15 to September 21, 1955 are reported. Potential gradient, temperature, humidity, wind velocity, and solar radiation were recorded, and measurements were made of the magnitudes: total as well as positive and negative electric conductivity of the air (950 measurements each), number of condensation nuclei (1025 measurements), relative radioactivity of the air (70 measurements, each covering four hours), and NO_2^--ion contents of precipitations and fogs (clouds). For the synoptic evaluation of the results, the records of 6 further atmospheric electric stations were used, which are situated at fixed places between 700 and 3000 m NN. Examples are given to show that atmospheric electric recordings at high level stations enable us to study the electric structure of the atmosphere during precipitations and in clouds of different kind (sheet clouds, shower and thunderstorm clouds). The behavior of electric field and conduction current in clouds of different types is described as well as in cases where precipitation changes from the solid into the liquid state and vice versa. Numerous measurements give information about the behavior of the electric conductivity of the air in the areas of: fogs and cloud fragments irradiated by the sun, downward currents from cumulus congestus tops, and downward currents below nocturnal inversions. There is a clear correlation between the NO_2^--ion concentration measured in precipitations and fogs, and the electric structure and electric activity of the clouds. In the Northern Alps, the radioactivity of the air is highly influenced by the wind; the maximum of radioactivity is found when the wind comes from SE-SW (origin of the radioactive substances: igneous rocks in the Central Alps). Numerous meteorological influences on the atmospheric radioactivity are discussed. (auth)

25626 ON THE AGE CALCULATION BY THE Pb U METHOD ON RADIOACTIVE MINERALS, CONTAINING COMMON LEAD. E. K. Gerling and Yu. A. Shukolyukov. Geokhimiya, No. 5, 403-10(1962). (In Russian)

A formula is deduced showing that for a group of minerals of the same age and the same area with different contents of U and radiogenic and common Pb the dependence between Pb^{206}/U^{238} and Pb^{207}/U^{235} is expressed by a straight line. According to the equation coefficients of the straight line the true age of the minerals and the isotopic composition of the captured "common" lead may be found. Examples of calculation according to data of various authors are given. (auth)

25627 ON THE GEOCHEMISTRY OF URANIUM AND THORIUM IN GRANITIC ROCKS OF THE KYZYL-TAU MASSIF (CENTRAL KAZAKHSTAN). CONTRIBUTION 2. OCCURRENCE FORMS OF RADIOACTIVE ELEMENTS IN GRANITIC ROCKS. V. I. Baranov, Tu Lich T'ien, and V. I. Korobkov. Geokhimiya, No. 5, 411-19(1962). (In Russian)

The occurrence of radioactive elements in granites of the Kyzyl-Tau massif was studied. Methods of microradiography of sections and mineral layers with the aid of a liquid nuclear emulsion were developed. Six occurrence forms of radioactive elements in granites were established. The variety of these forms may be explained by the crystallization differentiation of the magma, as well as by processes of autometamorphism, which is an important factor in secondary uranium supply. (auth)

25628 THE CRYSTAL CHEMISTRY OF BERYL. V. V. Bakakin and N. V. Belov. Geokhimiya, No. 5, 420-33 (1962). (In Russian)

In a number of crystal structures with three-dimensional frameworks of Si, Al, Be tetrahedra and large cavities between these tetrahedra, (zeolites and similar minerals), a deficiency of positive charge resulting from the substitution (in the process of mineral growth in changing conditions) of some standard cations by cations of smaller charge or simply from their absence ("omission") is found. When the cavities are large enough a compensation of this deficiency is easily attained by introducing additional cations of required charge (not appearing in the standard formulas) with dimensions fitting the dimensions of existing cavities. Most frequently the cavities are too large and in order to avoid rocking of the introduced cations in their places new participants are needed. These may be

ions or neutral particles which should form contacts between the cations introduced first and the insufficiently saturated anions in the framework itself (their role is that of special props or stretchers). In many cases the role of these stretchers is not only a passive one. In particular when such stretchers as H_2O molecules—carriers of protons—are present and when specific features of the structures do not ensure close contact between the cations introduced first (which as a rule are of moderate sizes) and the anions in the Si, Al, Be framework, these cations may hand over their functions of compensators to the protons of the H_2O molecules. These cations remain bearers of the formal charge but the H_2O molecules (which in such cases should be denoted as H^+ $(HO)^-$), beside their basic role as props, assume the functions of relay or buffer groups. One of the simplest structures of this kind is that of beryl, and a detailed study of its zeolitic properties predicts its predilection for Cs, Li, Na, its singular dislike for Rb, K, Mn, and its very high temperature of dehydration. (auth)

25629 ON THE ZIRCONIUM AND HAFNIUM RATIO IN ACCESSORY ZIRCON OF GRANITOIDS. V. V. Lyakhovich and I. D. Shevaleevskii (Inst. of Mineralogy, Geochemistry and Crystal Chemistry of Rare Elements, Moscow). Geokhimiya, No. 5, 440-52(1962). (In Russian)

The value of the ZrO_2/HfO_2 ratio in accessory zircon of granitoids remains rather constant and ranges from 35–40. The more basic (hybrid) granitoid varieties are characterized by the greatest value of this ratio (40–53) and the most acid, by the least value (21–28). In the genetically bound rock series: granites–aplites–pegmatites–quartz veins zircons from pegmatites are most enriched in hafnium. The maximum enrichment in hafnium (3.0 percent) is observed in zircons from albitized granites. (auth)

25630 ON THE CORRELATION OF GRANITE INTRUSIVES ON THE BASIS OF THE DETERMINATION OF LITHIUM AND BERYLLIUM CONTENT IN MICAS. V. G. Pentelkov (Inst. of Mineralogy, Academy of Sciences, USSR). Geokhimiya, No. 6, 497-500(1962). (In Russian)

The systematic increase of the lithium (7.5 times) and beryllium content (6 times) in biotites of the mesozoic granite complex compared to Early Kaledonian and Hercynian complexes is shown. The possibility of an age correlation of intrusive complexes on the basis of a different content of rare elements in micas is admitted. (auth)

25631 ON THE ZIRCONIUM-HAFNIUM RATIO IN MINERALS AND ROCKS OF THE LOVOZERO MASSIF. V. I. Gerasimovskii, A. M. Tusova, and I. D. Shevaleevskii (V. I. Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Geokhimiya, No. 6, 501-7(1962). (In Russian)

In the Lovozero intrusion (Kola peninsula) towards the end of the magmatic process, an increase in the ZrO_2/HfO_2 ratio from 40 to 60 occurs. The average value in this ratio for the whole massif is about 47. In zirconium minerals from rocks this ratio exceeds the average (in eudialite–54, in lovozerite–69) and in zirconium-containing minerals it is lower (in aegirine about 40 and in arfvedsonite 40–48). The differences in the values of the zirconium–hafnium ratio in minerals are conditioned by the incomplete identity of the Zr and Hf properties, as well as by crystallochemical factors. The highest ZrO_2/HfO_2 ratios are characteristic of minerals formed under conditions of postmagmatic processes. (auth)

25632 THE EFFECT OF SHOTPOINT MEDIUM ON SEISMIC COUPLING. W. M. Adams (Univ. of California, Livermore) and L. M. Swift. Geophysics, 26: 765-71(Dec. 1961). (UCRL 6059)

Two experiments on the coupling of seismic waves to the surrounding medium were conducted. One was performed at two overburden depths in a tunnel complex at the Nevada Test Site in the Oak Spring Tuff. The other was done at a depth of 800 ft in the Carey Salt Mine at the Winnfield Salt Dome near Winnfield, Louisiana. Free-field measurements within 400 ft of the chemical charges indicate that three to four times more energy was propagated into the elastic zone in the tuff than in the salt. There is some indication that in tuff the amount of energy transmitted into the elastic zone was dependent upon the lithostatic overburden pressure. Increasing the overburden pressure by a factor of about five almost quadrupled the energy propagated into the elastic zone. (auth)

25633 SEISMIC DECOUPLING FOR EXPLOSIONS IN SPHERICAL UNDERGROUND CAVITIES. William M. Adams and DeWitt C. Allen (Univ. of California, Livermore). Geophysics, 26: 772-99(Dec. 1961). (UCRL-6086 Rev.)

A series of paired explosions in a salt mine near Winnfield, Louisiana, was conducted to test a theory concerning seismic decoupling by underground cavities. The theory predicted a decoupling of 130. Free-field and surface measurements from an explosion in either a 6-ft- or a 15-ft-radius spherical cavity were compared with similar measurements from a completely-tamped explosion of equal size. Shot sizes were from 20 pounds to a ton. Surface measurements were made out to 100 km. at 0.05 to 100 cps. The experiment confirmed that decoupling does occur. For explosions that produce an average cavity pressure up to $\frac{1}{5}$ and possibly more of the lithostatic overburden pressure, seismic waves were decoupled by more than 100, i.e., two orders of magnitude. Even for explosions producing an average cavity pressure of six times the lithostatic overburden pressure, the seismic waves were decoupled by 20—more than a full order of magnitude. Minimum decoupling factors as a function of frequency are presented. (auth)

25634 THE MINERALIZATION OF URANIUM IN THE ITALIAN ALPS. F. Ippolito, P. Baggio, S. Lorenzoni, G. Marinelli, M. Mittempergher, and F. Silvestro. Ind. mineraria, (Rome), 12: 7p.(Jan. 1961). (CNEN-53) (In Italian)

The uraniferous mineralizations of Italian Alps are divided into three groups: mineralizations in schists, permian sandstones, and volcanites of late paleozoic. Fundamental genetic features, i.e. the nature of deposition area, the character of the mineralized solutions, the origin of uranium and other elements connected, are discussed for each of such types. The U-bearing mineralizations connected to the granite of Monte Bianco are described. (auth)

25635 RADIO-CHEMICAL EXAMINATION OF SYSTEMATIC ERRORS IN ROUTINE MINE ASSAYING OF WITWATERSRAND ORES. C. H. Coxom (RAND Mines Ltd., Johannesburg), C. J. Verwey, and D. N. Lock. J. S. African Inst. Mining Met., 62: 546-78(May 1962). (In English)

Experiments with gold-198 and silver-110 were performed to determine the magnitude of the systematic errors in the standard fire assay for gold. The influence of flux, the control of temperature of cupellation, and alterations to parting technique are described. It is shown that routine mine assays give values about 2% too low, made up as follows: gold lost to crucible, slag and button dressing, 0.5%; gold lost to cupel, 0.7%; dilution by iron during pulverizing, 1.2%; less silver retained when parting bead, 0.4%. As the major loss occurs during cupellation, attempts at improving the quality of cupels were made but were not encour-

aging. The introduction of a correction factor is discussed. (auth)

25636 ELECTROMAGNETIC RADIATION FROM A NUCLEAR EXPLOSION IN SPACE. W. J. Karzas and R. Latter (RAND Corp., Santa Monica, Calif.). Phys. Rev., 126: 1919-26(June 15, 1962).

The γ rays from a nuclear explosion in space Compton-scatter electrons near the surface of the device or in a surrounding material shield. The scattered electrons leave the surface and are accelerated back toward it by the positively-charged matter. Provided they are asymmetrically distributed, the accelerating electrons radiate an electromagnetic signal. The electron motions are analyzed, the electromagnetic signal is estimated, and its detectability is discussed. For a typical nuclear explosion, the electromagnetic signal is independent of the yield and contains frequencies up to 10 to 100 Mc and thus will penetrate the ionosphere. Taking into account dispersion by the ambient interplanetary plasma ($\approx 10^3$ electrons/cm^3), the peak electric field strength at R kilometers from the explosion is $\approx 10^4\ R^{-\frac{3}{4}}$ v/m. The pulse length is $\approx 10^{-10}$ R sec. If only background cosmic noise limits detectability of the signal, the maximum detectable range is about 10^6 km. (auth)

25637 MODERN EXPLORATION FOR COAL. K. Spink. Research (London), 15: 295-8(July 1962).

Methods of coalfield exploration are discussed, particularly the use of drilling. Borehole logging with a gamma/gamma log is described. The device depends on the detection of density differences instead of making density measurements. (auth)

25638 CONTRIBUTION TO THE KNOWLEDGE OF PORTUGUESE URANIUM MINERALS. Francisco J. Mendes and A. F. A. Sanches Furtado (Junta de Energia Nuclear, Lisbon). Rev. Fac. Cien., Univ. Lisboa, 2a Ser., C, 8: 97-108(1960). (In Spanish)

Some samples of a mineral (Sabugalite) coming from Castelejo deposits (Beira Province) were studied and are described. The mineral is present in aggregates of thin tabular crystals whose flattening plane is (001) under preferential orientation or in platings formed of very elongated crystals oriented along two perpendicular directions, frequently associated with other uranium phosphates. It has a lemon yellow coloration, mother-of-pearl-like bursts, perfect (001) cleavage and very good (100) cleavage. The hardness is 2 to 3 and density 3.175. It is pleochroic with birefringence ($0.012 \cong n_g - n_p \cong 0.015$) and has positive elongation. The angle of extinction is 10°; $50° < 2V < 70°$, and the indices measured were $1.571 \cong n_g \approx n_m \cong 1.585$ and $1.562 \cong n_p \cong 1.571$. There is a lemon green fluorescence. The crystallographic study permits the conclusion that the crystalline maille is very close to a quadratic with unitary parameters $\underline{a}_0 \approx \underline{b}_0 = 6.98$ and $\underline{c}_0 = 19.2$ A. The symbolization was made for all the important refractions ($1 \cong 2$). The spatial group is I 4/m m m. (tr-auth)

25639 PROPAGATION OF SHOCK WAVES AT REMOTE DISTANCES FROM AN EXPLOSION POINT IN A CONSTANT-DEPTH BASIN. B. A. Lugovtsov. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 3, 31-9(May-June 1962). (In Russian)

A system of equation developed for so-called short waves and expressing the propagation velocity as a function of amplitude was previously used in an analysis of one-dimensional shock-wave asymptotics and of shock-wave reflection from a free surface and a hard wall. The same equations are applied in an analysis of explosions with a radius comparable to a water basin depth and of the flow produced by shock waves at distances remote from the explosion point. (R.V.J.)

25640 EXPERIMENTAL STUDIES OF CONTROLLED GROUND EXPLOSION. V. M. Kuznetsov and E. N. Sher. Zhur. Priklad. Mekh. i Tekn. Fiz., No. 3, 53-8(May-June 1962). (In Russian)

Data are given from experimental studies of a method for detonating ground explosives with completely controlled direction of the ejection and dispersion. (R.V.J.)

25641 METHODS OF DETERMINING SAND MOVEMENT BY MEANS OF RADIOACTIVE LABELED SAND. O. Callesen and K. Otterstrom. p. 41-9 of "International Congress of Navigation. 20th, Baltimore, 1961. Ocean Navigation. Sect. II." Brussels, Secrétariat Général A.I.P.C.N., 1961.

Beach drifting on the west coast of Denmark at the Thyborn inlet, which intersects the northern part of Jutland, was studied because it was difficult and costly to keep the inlet open for navigation. Before any maritime work could be undertaken, the sand movements caused by littoral drift and strong currents were measured by sand labeled with Cr^{51}. For this purpose, sand was treated with HNO_3 and cooled in Na(OH) to give it an affinity for Cr. Active metallic Cr powder was dissolved in HCl and transformed to $Na_2\ Cr^{51}\ O_4$ by adding NaOH solution. The sand was heated with the active chromate solution and then dried at 200°C. In this way 2.5 kg portions of sand were labeled with 4c; the yield being 55%. With this sand, 2 experiments were carried out in which 15 kg of labeled sand was deposited. After 48 hr, the activity distribution at the bottom of the inlet was measured with a specially constructed robust scintillation counter with photomultiplier, which was dragged along by a barge. The activity was traced 6 km from the deportation point, and a good picture of the sand movement was obtained. (auth)

HEALTH AND SAFETY

25642 (CEA-2159) COMPTE RENDU D'EXPERIENCES DE PLUSIEURS ANNEES SUR L'ABSORPTION DU STRONTIUM ET DU CESIUM RADIOACTIFS PAR DES PLANTES CULTIVEES. (Results of Several Years Experiments on the Absorption of Radioactive Strontium and Cesium by Cultivated Plants). [F.] Huguet, et al. (France. Institut National de la Recherche Agronomique, Paris and France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). 1962. 21p.

The absorption of cesium-137 and strontium-90 by vines, permanent pasture, potatoes, green vegetables, tomatoes, onions, cabbage, and beans in France in 1960 is presented. The strontium coefficient has varied very little from one year to the next and that of cesium has slightly diminished. The values obtained suggest that the concentrations in irrigation water should not exceed one fifth of the maximum permissible concentration in drinking water. (auth)

25643 (CEA-2163) DOSE DELIVREE APRES UNE ABSORPTION UNIQUE D'UN MELANGE DE PRODUITS DE FISSION. (Dose Received After a Single Absorption of a Fission Product Mixture). G. Vacca (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1962. 17p.

During an accident a person can absorb a certain quantity of fission products. The doses received by the entire body or by a particular organ depend on the time spent in the reactor by the fuel element and the cooling time of the fission products. Calculations were made for an irradiation time of 300 days and for a cooling time of between 1 day and 3 years. (auth)

25644 (CLOR-9) ROŚLINY JAKO WSKAŹNIK RADIOAKTYWNEGO SKAZENIA TERENU. (Plants as Monitors of Radioactive Pollution of the Environment). R. Szepke (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centraine Laboratorium Ochrony Radiologicznej, Warsaw). 1961. 88p.

Samples of pine needles, clover, grass, and cereals (mostly wheat) were examined for gross beta activity. Potassium content was determined in the ash of several samples. The radioactivity in plants was found to be several times greater than the natural activity due to potassium. The decay of mixed fission products in plant ashes was examined and the average half life determined as 270 days. Ash radioactivity of pine needles, clover, and grass was found to be proportional to fall-out rate. A correlation between radioactivity of pine needles and their age was also observed. An attempt was made to find a correlation between radioactivity of grasses and its species and between pine needle activity and its topographical location and/or origin on the tree. The possibility of using pine needles as a monitor of radioactive pollution of the environment is discussed. (P.C.H.)

25645 (CLOR-11) LATENT IMAGE FADING IN DOSIMETER FILM EMULSIONS. T. Musiałowicz and J. Wysopolski (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centraine Laboratorium Ochrony Radiologicznej, Warsaw). 1961. 12p.

Latent image fading in film emulsions produced by Foton for dosimeter purposes is investigated with regard to the influence of time. The decrease of density caused by latent image fading in normal conditions of storing and relative humidity of 50 to 80% does not exceed 10% during a year. This corresponds to the dose reading error up to 20%. (auth)

25646 (ERDL-1691-TR) THE SM-1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM, NOVEMBER 1954–DECEMBER 1960. Maurice Pressman and Paul B. Pruett (Army Engineer Research and Development Labs., Fort Belvoir, Va.). Aug. 31, 1961. 54p. (AD-271023)

An environmental radiological monitoring program was conducted. All data obtained during a period extending from 1½ years prior to SM-1 reactor start-up through more than 3 years of reactor operation are summarized. The period extended from November 1954 through December 1960. Samples assayed for radioactivity include river water and bottom silt, SM-1 condenser cooling water, subsurface ground water, rain and snow, atmospheric particles obtained by air filtration and fallout, and biota. The report concludes that after more than 3 years of SM-1 reactor operation, no significant increase has been noted in the radiological background level in the Fort Belvoir area. (auth)

25647 (EURAEC-164) DESIGN AND ECONOMIC STUDY OF SPENT FUEL SHIPPING. Quarterly Report, May 1, 1961 to June 30, 1961. Gerald Fisher (Stanray Corp., Chicago). June 28, 1960. Work Performed under United States-Euratom Joint Research and Development Program. Contract AT(11-1)-963. 8p.

An investigation is being made of the problems involved in the shipment of spent radioactive fuel elements from a reactor located in one of the EURATOM nations to a reprocessing site in the United States. A general list of all the factors and agencies that might come to bear on the problem was drawn up. (M.C.G.)

25648 (GA-2782(Rev.)) A PROGRAM OF RESEARCH FOR THE DETERMINATION OF RARE-EARTH ABUNDANCES IN METEORITES. Quarterly Progress Report for the Period Ending December 15, 1961. R. A. Schmitt and R. H. Smith (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Dec. 29, 1961. Contract NASr-75. 41p.

Activities are reported in a program to determine rare-earth concentrations in chondritic and achondritic meteorites by neutron-activation and photoneutron analysis. Data were obtained during the report period by neutron-activation on carbonaceous, enstatitic, and bronzitic chondrites. Relative concentrations in these samples were found to be nearly identical from Nd to Lu. All data obtained in the program on rare-earth concentrations in meteorites are included. (J.R.D.)

25649 (HASL-128) SURVEY OF FALLOUT OPERATIONS. (New York Operations Office. Health and Safety Lab., AEC). July 1, 1962. 198p.

A survey was made of fall-out operations in the various countries of the world. These operations are outlined by country. The source of information has largely been the reports submitted to UNSCEAR forwarding data for their consideration. In addition, some material has been received directly in exchange for HASL Quarterlies and other publications of the Laboratory. In many cases, responsible scientists from the country concerned have reviewed the sheets and have made corrections. All of the programs that are shown have been and are subject to modification as time goes on, thus, the data indicate the status of the program as of 1961. No attempt has been made to list re-

search projects or special fall-out measurements and only programs of a continuing nature have been covered. (auth)

25650 (HW-52448) BETA FIELD DOSE RATE DETERMINATION FOR ANGULAR RESPONSE WITH THE SOUP BOWL DOSE RATE METER. J. F. Evans (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 12, 1957. Contract AT(45-1)-1350. 9p.

The Soup Bowl dose rate meter is evaluated for determining the beta field dose rate for an extended source and the magnitude and characteristics of its correction factors. Correction factors were calculated as the ratio of the total integrated dose rate independent of angular response to the total integrated dose rate dependent on angular response. Correction factors were determined for source sizes from 6 to 72 inches in diameter and for source-plane to chamber distances from 4 to 32 inches. The maximum correction factor was found to be 1.1 ± 0.5, occurring at a source-plane chamber distance of 12 inches for a 72-inch diameter source. The high energy particles contributed no significant change to the readings, and thus the high and low energy cases were considered as one. (N.W.R.)

25651 (HW-71574) A LABORATORY STUDY TO DEFINE CONDITIONS FOR LOADING STRONTIUM-90 ON DECALSO FOR HAPO-1A CASK SHIPMENT. F. M. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 30, 1961. Contract AT (45-1)-1350. 31p.

One of the major tasks involved in the recent Hanford strontium-90 recovery program was the purification of some 60,000 curies of strontium-90. One facet of this work was the defining of conditions necessary to contain and hold the strontium-90 for shipment from Hanford to Oak Ridge, where it would be pelletized and packaged. Of the methods considered for shipment, that accepted was the absorption of the strontium onto an inorganic exchanger contained in some suitable vessel. Decalso, a synthetic sodium aluminosilicate, showed this to be feasible. As a result, a special annular-shaped insert to hold Decalso, interchangeable with the filter unit of the HAPO I cerium cask already on hand, was designed. This insert was designed to hold 1.4 cubic feet of Decalso and was equipped with the necessary lines for slurrying the Decalso in and out and for the circulation of the strontium-90 product solution through the Decalso. This insert was sealed into the cerium-cask body, and the combination is referred to as the HAPO-IA cask. To protect the cask against both mechanical shock and excessive heat in event of a fire, it was placed in an insulated buffer for shipment across country. A series of experiments are described that were performed to define the conditions necessary for loading the cask from the different types of strontium product solutions obtained from the recovery process in A-Cell. (C.H.)

25652 (IDO-12021) HEALTH AND SAFETY DIVISION ANNUAL REPORT, 1961. (Idaho Operations Office. Health and Safety Div., AEC). May 21, 1962. 210p.

Major aspects of the health and safety program are discussed. Topics covered include: health physics at SL-1, medical services, personnel metering, analysis, hazards control, site survey, ecology, instrument and development, and environmental monitoring. (M.C.G.)

25653 (KY-419) ENVIRONMENTAL MONITORING SUMMARY FOR THE PADUCAH PLANT FOR 1961. E. G. Brown and R. C. Baker (Union Carbide Nuclear Co. Paducah Plant, Ky.). July 20, 1962. Contract W-7405-eng-26. 14p.

Outdoor monitoring of air, water, and vegetation in the vicinity of the Paducah Plant is summarized for the year of 1961. (auth)

25654 (ORNL-TM-278) PERSONNEL-EXPOSURE AND CONTAMINATION CONTROL IN THE ROUTINE OPERATION OF THE ORNL RESEARCH REACTORS. T. M. Sims (Oak Ridge National Lab., Tenn.). July 31, 1962. Contract W-7405-eng-26. 35p.

Measures are outlined that are taken to control occupational radiation exposure incurred in the routine operation of a reactor and in the conduct of activities associated with its operation. Those measures taken to minimize the frequency and effects of minor radiation and contamination incidents are also discussed. (C.H.)

25655 (TID-14960) KIWI-A^3 PLAN 216-B. On-Site Rad-Safe Report. (Reynolds Electrical and Engineering Co., Inc. Radiological Safety Div., Mercury, Nev.). Apr. 1961. Contract [AT(29-2)-162]. 28p.

Radiation surveys were performed to provide radiological safety information and to obtain fallout parameter data. Procedures and equipment are described. Results are presented in tables and graphs. Radiation monitoring by portable instruments before reactor removal was sufficiently accurate to allow effective radiation exposure control. The data obtained from counting fallout trays seemed to indicate that most of the fallout activity was carried up and over the near fallout stations. The activity level at most of the stations was statistically not more than background. Data from the Victoreen Remote Area Monitoring System following shutdown of the reactor indicated that accuracy of radiation intensity readings is affected by neutron activation of the sensing elements. (M.C.G.)

25656 (USNRDL-TR-557) RESIDUAL CONTAMINATION OF QUARTERMASTER CORPS CLOTHING AND PACKAGING MATERIALS. RETENTION OF SIMULATED DRY FALLOUT PARTICLES. F. K. Kawahara (Naval Radiological Defense Lab., San Francisco). Mar. 23, 1962. 30p.

A study was conducted to determine the amount and size of simulated dry fall-out particles retained by various Quartermaster Corps clothing and packaging materials, after field decontamination procedures are applied. An attempt was also made to correlate qualitatively the amount retained with surface properties of the materials. Dry spherical, glass beads in selected size-distribution groups (14-270, 14-100, and 14-75 μ) were used to simulate fall-out particles from a nuclear detonation. The amount remaining was measured gravimetrically and visually by optical microscope after application of three mechanical removal operations. It was found that materials having entrapping fibers retained the largest amount of beads. The amount was directly proportional to the number of open spaces and the number of loose fibers that acted as entrappers. Scrim-back packaging material retained 0.3 g/ft^2 of particles which had an average diameter of 50 μ. Cotton sateen clothing and cotton poplin clothing had lesser amounts. All other materials tested retained zero or insignificant amounts. Mechanical entrapment of particles by the loose fibers appeared to be the principal mechanism of retention. (auth)

25657 (WT-359) F.C.D.A. FAMILY SHELTER EVALUATION. Archie P. Flynn (Federal Civil Defense Administration, Washington, D. C.). Mar. 1952. Project 9.1a [of] OPERATION BUSTER. 90p.

In order to determine the effects of atomic explosions on

small civil defense shelters for family use, 29 simple structures were built along an arc 1200 ft from the target point and exposed to Buster Bursts B, C, and D. The structures were of four basic types; covered-trench, metal-arch, wood-arch, and basement lean-to. Because of poor cohesive properties of the soil, much of the earth cover on the shelters was removed by the first shot. Since test procedures prevented restoration of structures and replacement of cover after each blast, test results were materially affected. Partly above-grade cover-trench shelters provided less protection against blast than below-grade cover-trench shelters and were much less desirable as protection against gamma radiation. Metal-arch shelters set in concrete appeared to have good potentialities with minor design modifications. Wood-arch shelters as designed, proved to be unsuitable substitutes for metal-arch shelters. No worthwhile information was obtained on basement lean-to shelters. Unusual conditions disclosed design deficiencies in entrance construction, front, and end sections, and effective earth cover. Small shelters are potentially capable of meeting requirements of civil defense. (auth)

25658 (AERE-Trans-895) FUNDAMENTALS AND POSSIBILITIES OF FILM DOSIMETRY. K. Becker. Translated by J. B. Sykes (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England) from Atompraxis, 4: 168-75(1958). 21p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, abstract no. 11606.

25659 (JPRS-13691) TRANSLATIONS FROM THE JOURNAL GIGIYENA I SANITARIYA. Translated from Gigiena i Sanit., 27: No. 2, 19-24; 34-7; 67-71; 100-2 (1962). 26p.

A translation of 4 selected articles from Gigiyena i Sanitariya (Hygiene and Sanitation), Vol. 27, No. 2, 1962 is presented. Separate abstracts were prepared for 3 of the papers. The fourth concerned the carcinogenic properties of exhaust gas soot of motor transport. (M.C.G.)

25660 (JPRS-13691(p.8-12)) HYGIENIC EVALUATION OF CONSTRUCTION MATERIALS AND DEACTIVATING AGENTS USED FOR RIDDING THEM OF CONTAMINATION WITH RADIOACTIVE IRON. Translated from Gigiena i Sanit., 27: No. 2, 34-7(1962).

A comparative characterization was made of some construction and finishing materials from the viewpoint of their ease of decontamination from Fe^{59} by various wetting agents. It was found that residual contamination of silicate, plexiglass, 57-40 masticated rubber, and stainless steel did not exceed the background level of the instrument after a single decontamination by kerosene and heated solutions of alkaline permanganate and acids. After decontamination with soap pastes, 9% HNO_3, and wetting agent OP-7 the residual contamination in various cases slightly exceeded the background level of the instrument and varied within the limits of 0.15 to 1.7%. Residual contamination of these samples after repeated contamination and washing was of the order of 0.5 to 4.1%. Samples of linoleum and ceramic and glazed floor tile showed residual activities after washing from 1.1 to 58.2%, and up to 100% after repeated cycles of contamination and washing. (M.C.G.)

25661 (JPRS-13691(p.13-19)) SANITARY-HYGIENIC REQUIREMENTS OF CENTERS AND STOREHOUSES OF RADIOACTIVE ISOTOPES. A. V. Terman and I. P. Korenkov. Translated from Gigiena i Sanit., 27: No. 2, 67-71 (1962).

An attempt was made to develop hygienic and safety standards for storehouses and shipping centers for radioisotopes. (M.C.G.)

25662 (JPRS-13691(p.20-4)) CONDITIONS OF SUPER-HIGH FREQUENCY ELECTROMAGNETIC FIELD IRRADIATION OF THOSE WORKING ON THE TUNING AND TESTING OF RADIO ENGINEERING INSTRUMENTS. Yu. A. Osipov, E. (Ye.) L. Kulikovskaya, and T. V. Kalyada. Translated from Gigiena i Sanit., 27: No. 2, 100-2(1962).

The irradiation conditions for people working in tuning and testing of various radio engineering instruments conducted with the use of low power klystron generators as sources of super-high frequency energy were investigated. Chiefly the hands of the workers come into the directed flux of electromagnetic energy, while the chest and head are not irradiated or are in a field which is of the intensity of several $\mu w/cm^2$. The use of dead ends in the generator circuits is recommended for protecting the workers, along with shorter working hours. (M.C.G.)

25663 A RADIOISOTOPE ACCOUNTABILITY SYSTEM. R. E. Ogborn, A. L. Dunn, and E. L. Lahners (Veterans Administration Hospital, Omaha). Am. J. Roentgenol., Radium Therapy Nuclear Med., 88: 355-7(Aug. 1962).

A system is described for keeping records of receipt, usage, and disposal of radioisotopes. The system is simple and effective. (C.H.)

25664 RADIATION AND TOXICITY HAZARDS OF URANIUM ALLOYS. G. G. Eichholz. Can. Nuclear Technol., 1: 33-4(1962).

Problems involved in the general use of uranium as alloying additions in steel are discussed. It is demonstrated that there should not be any difficulty in staying well below maximum tolerance levels under practical conditions for the alloys considered. Testing procedures for determining uranium concentrations present are described. (M.C.G.)

25665 USE OF DOSIMETRIC APPARATUS IN SANITATION PRACTICE. R. V. Stavitskii (Central Inst. for Post Graduate work in Medicine, USSR). Gigiena i Sanit., 26: No. 8, 53-7(1961). (In Russian)

Characteristics, applications, and advantages of dosimetric devices are tabulated and discussed. (R.V.J.)

25666 A GLANCE AT INSURANCE AGAINST NUCLEAR RISKS. Theodore C. Pontzen. Inds. atomiques, 6: 91-6 (1962). (In French)

Insurance against nuclear risks entails the solution of problems different from those faced in insuring against other risks. The statistics to be found in this area, the insufficiency of reserves, irradiation risks, risks from military usages, nuclear propulsion, federal insurance, and the insurance scheme are problems to be solved. (J.S.R.)

25667 PRODUCTION OF ELECTRICAL ENERGY FROM RADIOACTIVE ISOTOPES. P. Wenzel. Isotopentechnik, 3: 85-92(Mar. 1962). (In German)

After a brief review of the general characteristics of nuclear batteries, the various types of nuclear batteries described in the literature are reviewed. The principal individual characteristics are given. (tr-auth)

25668 GONAD EXPOSURE IN THE I^{131} THYROID FUNCTION TEST, WITH SPECIAL CONSIDERATION TO I^{131} IN THE URINARY BLADDER (ENGLISH TEXT). H. Irie, et al. (Kyushu Univ. Faculty of Medicine, Fukuoka). Kyushu J. Med. Sci., 12: No. 3, 83-91(1961).

A formula to determine gonad exposure to γ rays from I^{131} accumulated in the urinary bladder and stomach is presented: $D = 2.03 \times 10^{-2} \alpha Y_n + 0.0334$ Dad. α is dependent only on the frequency of urination during the 24 hours after administration of I^{131}; Y_n is the excreted amount of I^{131} in μc within 24 hours after administration, and Dad is the

total amount of I^{131} administered in μc. The value varies with the frequency of urination. (Abstr. Japan Med., 2: No. 6, June 1962)

25669 NUCLEAR TRANSPORTATION ACCIDENTS. Francis L. Brannigan and George S. Miles. Natl. Safety News, 85: No. 5, 38-9; 62; 64-5(May 1962).

Methods of fighting fires involving shipments of radioactive materials are described. Regulations in shipping are outlined. Examples are discussed. (M.C.G.)

25670 ZIRCONIUM POWDER. Data Sheet 382 (Revised). Natl. Safety News, 85: No. 5, 42; 115-24 (May 1962).

Data on zirconium powder are presented. Properties, uses, hazards, shipping, storage, handling, personal protective equipment, ventilation, control of static, electrical equipment, fire extinguishment, first aid, and waste disposal are discussed. (M.C.G.)

25671 REGULATORY CONTROL. A REVIEW OF NATIONAL AND INTERNATIONAL REGULATIONS FOR THE TRANSPORT OF ACTIVE MATERIALS. Nuclear Eng., 7: 268-72(July 1962).

In the transport of active materials, special precautions must be taken, particularly in the design and construction of containers for highly active materials. A review is given of these precautions, as interpreted through the various regulations that are enforced both internationally and nationally. (auth)

25672 TYPE B PACKAGES. DESIGN CRITERIA. A. Grange (Atomic Weapons Research Establishment, Aldermaston, Eng.). Nuclear Eng., 7: 274-6(July 1962).

Safety considerations in the design of containers meeting the International Atomic Energy Agency Class B standards are discussed. Drop, fire, and water-immersion test requirements for the containers are outlined. Class B requirements for containers for fissile materials are also outlined. (T.F.H.)

25673 RADIOISOTOPE CONSIGNMENTS. Nuclear Eng., 7: 277-9(July 1962).

The regulations, operation experiences, commercial considerations, packaging requirements, and safety record of the Radiochemical Centre, which is the radioisotope distribution agency of the United Kingdom Atomic Energy Authority, are outlined. (T.F.H.)

25674 FIFTH REPORT ON STUDIES ON RADIOACTIVE PRECIPITATION. T. A. Bródy, Silvia Bulbulian, José Calvillo, and A. M. Martínez (Universidad Nacional, Mexico). Rev. mex. fis., 11: 1-30(1962). (In Spanish)

Fall-out data for February 1959 to October 1961 for 13 stations in Mexico are presented. Eleven stations employed the gummed-paper method only, one station employed a free water surface, and one employed both methods. Approximate figures for infinite y doses and Sr^{90} precipitation were deduced. The latter are compared with radiochemical determinations of Sr^{90} in rain water. Agreement is reached to within about 50%; the validity of the gummed-paper method is checked. Data on the radiochemical determination of Sr^{90} in milk and human bones are included. (auth)

25675 EXTERNAL GAMMA DOSE RATES FROM NATURAL RADIONUCLIDES IN JAPAN. Tadayoshi Doke (St. Paul's Univ., Japan), Hisao Takahashi, Takenobu Higashimura, Masashi Takeuchi, Yukio Nagahara, Hironobu Watanabe, Hideko Otsuka, Masaharu Okano, and Fumio Yamasaki. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 56: 40-6(Mar. 1962). (In English)

Measurements of environmental radiation dose rate due to natural radioactive elements are made by different methods with various detectors. Two geologically different zones in Japan are chosen and comparison is made between the dose rates obtained in these zones. On confirming that the result of outdoor surveys is about the same as that obtained by measuring in laboratory the samples of soil brought from the spots, outdoor dose rates of fourteen different places in the two zones are determined. Measurements on indoor dose rates are also made in a study of the effect of various structural materials. The dose rate found ranges between 20 and 130 mr per year. (auth)

25676 AIR CONDITIONING IN ISOTOPE LABORATORIES. F. Zimmermann. Tech. Gemeinsch., 9: 266-8 (July 1961).

The ventilating systems are classified into heating, air conditioning, and climatic systems. Heating systems, using radiators, should be avoided because they are subject to corrosion and promote the deposition of dust which is readily activated. The official standards and directions are discussed for admitting fresh air, changing used air, constructing laboratory hoods and gloveboxes, climatizing and decontaminating the air, and general protective measures for emergencies. Particular emphasis is placed on the materials used for ventilating systems, the proper construction of the laboratories, and the economy of adequate ventilation. (OID)

25677 OCHISTKA VODY I STOCHNOI ZHIDKOSTI OT RADIOAKTIVNYKH IZOTOPOV. (Purifying Water and Sewage from Radioactive Isotopes). G. V. Yakimov. Moscow, Izd-vo M-va Kommunal'nogo Khozyaystva RSFSR, 1961. 84p.

Radioactive waste disposal and water contamination problems are discussed. Data are given on biological effects of radiation, sources of water contamination, and properties of various radioactive elements. Decontamination practices for water, sewage, and solids are analyzed, and methods for dosimetric control and various monitoring devices are surveyed. (R.V.J.)

25678 GIGIENA TRUDA PRI RABOTE S URANOM I EGO SOEDINENIYAMI. (Industrial Hygiene in Handling Uranium and Its Compounds). O. S. Andreeva. Moscow, Medgiz, 1960. 96p.

Data are presented on the physico-chemical properties of uranium and its fission products; biological effects, toxicity, distribution, and elimination of uranium in organisms; and safety measures in handling uranium-containing materials. Special attention is given to dosimetric and medical control of personnel and to hygiene. (R.V.J.)

25679 CODE OF PRACTICE FOR THE DISPLAY OF SOURCES OF IONIZING RADIATIONS AT EXHIBITIONS. (Gt. Brit. Ministry of Health). 1961. $0.07(BIS).

A code of practice is presented for the display of sources of ionizing radiations at exhibitions. The code considers the safety of the exhibitor and the public. (C.H.)

25680 IONISING RADIATIONS: PRECAUTIONS FOR INDUSTRIAL USERS. Safety, Health and Welfare. New Series No. 13. (Gt. Brit. Ministry of Labour, London). Nov. 1961. 63p. $0.35(BIS).

Safety measures are outlined for the protection of personnel during industrial uses of x rays and sealed radioactive sources. General principles of radiological protection are reviewed and general and special precautions are discussed. (C.H.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

25681 (TID-15144) SURVEY OF PACKAGING REQUIREMENTS FOR RADIATION PASTEURIZED FOODS. George O. Payne, Jr. and Clement C. Schmiege, comps. (Continental Can Co., Inc., Chicago). July 31, 1962. Contract AT(11-1)-989. 140p.

Literature pertinent to the use of packaging materials for radiation processed foods was reviewed and tabulated. Conclusions drawn from the data were applied to the probable package engineering requirements of five fishery and five fruit products under investigation for shelf life extension by radiopasteurization. The needed research and field testing program is outlined. A bibliography of approximately 450 references and 18 tables of data is included. (auth)

25682 (TID-16013) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Quarterly Progress Report No. 13, December 15, 1961–March 15, 1962. (Chicago. Univ. Labs. for Applied Science). Contract AT(11-1)-712. 18p. (LAS-SR-161-43)

Wear studies under modified corrosive wear conditions were made on radioactive piston rings installed in an electrically loaded, single-cylinder, air-cooled gasoline engine The level of activity transferred to the lubricant was continuously monitored. Ring wear was found not to be a critical index of the over-all quality of engine lubricants. The data on moisture determination for coal in large storage piles using neutron moderation are being collected and extended. Instruments were developed for applications of Rutherford scattering to chemical analysis of solids. (M.C.G.)

25683 UTILIZATION OF ISOTOPES FOR CONTROL APPARATUS WITH THE OBJECT OF AUTOMATION. S. Margolinas. Automazione e strumentazione, 9: 81-6 (1961). (In Italian)

Within the framework of the development of automation in industry, applications of artificial radioisotopes are playing an increasingly important role. Numerous continuous and non-destructive measurements can be made with x, γ, β, and α rays. These measurements are translated by electric signals which can control all the regulation and automation systems. In the present article several devices using radioisotopes for industrial measurements are described. A brief review of the theoretical principles serves as an introduction. The devices described are level indicators, densitometers, and sulfurimeters. (J.S.R.)

25684 THE USE OF IONIZING RADIATION FOR THE VULCANIZATION OF SILICONE RUBBER. A. S. Kuzminski. Rev. Gen. du Caoutchouc, 38: 1811-14(Dec. 1961).

Ionizing radiation was applied to silicone rubber by a high-powered x-ray machine and by γ radiation using a Co^{60} source of 20000 c. SiO_2, TiO_2, ZnO, $CaSiO_3$, coal, and lamp black were used as filling materials. It was concluded that radiovulcanization of silicon rubber does not require the application of peroxides which have undesirable side-effects, high temperatures, and it is easy to control and gives a reliable product. The radiovulcanization of polydimethylsiloxane rubber requires only relatively weak radiation doses, and therefore, requires less time than the vulcanization of other rubbers. The radiovulcanized silicone rubbers are superior to chemically vulcanized silicon rubbers because they show greater resilience, shorter relaxation time, and less residual deformation upon compression at high temperatures. (auth)

25685 FOOD PRESERVATION BY IRRADIATION. OTS Selective Bibliography. (Office of Technical Services, Washington, D. C.). May 1962. (SB-403(Rev.))

References (185) are given to patents, reports, and periodicals published from December 1951 to January 1962. (P.C.H.)

ISOTOPE SEPARATION

25686 (CEA-2160) REGULATION DES CONCENTRATIONS DANS UNE USINE DE SEPARATION ISOTOPIQUE. (Concentration Control in an Isotope Separation Plant). R. Jacques (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1962. 37p.

Concentration control is examined for the case of a gaseous diffusion plant for uranium isotope separation. The effects of various typical perturbations are described and adequate systems of corrective actions are determined according to selected criteria. (auth)

25687 (AEC-tr-5069) SEPARATION OF ISOTOPE MIXTURE BY NOZZLE PROCESS. Hisashi Mikami and Yoshitoshi Oyama. Translated from Nippon Genshiryoku Gakkaishi, 2: 291-5(1960). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 18085.

25688 (AEC-tr-5199) PROCESS FOR THE PRODUCTION OF DEUTERIUM AND ITS COMPOUNDS AS WELL AS OTHER LIGHT ISOTOPES. P. Maldague. Translated by M. S. Feldman (Savannah River Lab., Aiken, S. C.) from French Patent 1,231,593. Apr. 11, 1960. 3p.

A process for the production of deuterium and its compounds as well as other light isotopes was developed based on the spectrometric resonance of hydrogeneous molecules. In production of deuterium, halogen hydracides composed of 99.985% halogen hydride molecules (HX) and 0.015% halogen deuteride molecules (DX) were subjected to a monochromatic radiation with a wave length corresponding to that of the resonance peak of DX. The HX molecules did not undergo any perceptible action, but the DX molecules were dissociated into deuterium and halogen in the nascent state. Gaseous deuteriun or deuterium compounds can be formed. This process can also be applied to other light isotopes. (M.C.G.)

25689 THE SEPARATION OF LITHIUM ISOTOPES BY ION EXCHANGE. J. E. Powell (Ames Lab., Ames, Iowa). J. Inorg. & Nuclear Chem., 24: 183-6(Feb. 1962). (In English) (IS-278)

The single-stage separation factor for the separation of Li^6 and Li^7 by distribution between a solution of lithium acetate and the lithium form of a sulfonated styrene-divinylbenzene copolymer (Dowex 50X24) was measured by a method of frontal analysis. The value obtained was 1.0026 ± 0.0003. The comparative merits of elution and displacement chromatography as means of resolving lithium isotopes were discussed. (auth)

MATHEMATICS AND COMPUTERS

25690 (RM-3184-PR) INFERENCE OF MONTE CARLO PROPERTIES FROM THE SOLUTION OF A KNOWN PROBLEM. J. I. Marcum (RAND Corp., Santa Monica, Calif.). June 1962. Contract AF49(638)-700. 35p.

It is shown that the probability density function $dp = 2dx/x^3$, where $x > 1$, is a reasonable approximation to sampling distributions found in several Monte Carlo transport codes. A machine code was set up which was used to obtain 10,000 runs of 10 samples each from the above distribution function. Histograms of the probability density function for the mean value, standard deviation of the mean, and Student's ratio of 10 samples were obtained. Because the standard deviation has an infinite expected value, it is of doubtful usefulness in measuring the probable error of, or placing confidence limits on, the mean value of the sample. The results obtained, however, show that with proper precautions the sample standard deviation may be used to establish confidence limits on the sample mean in spite of the fact that it has an infinite expected value. A further examination of the results sheds light on other properties of Monte Carlo solutions, including the fact that the results are biased. Althought the results of this problem do not allow one to make quantitative improvements in the interpretation of Monte Carlo results, they do uncover several qualitative features of the Monte Carlo results that allow for more lucid interpretation. (auth)

25691 (WAPD-TM-327) BLOCK ITERATIVE METHODS FOR TWO-CYCLIC MATRIX EQUATIONS WITH SPECIAL APPLICATION TO THE NUMERICAL SOLUTION OF THE SECOND-ORDER SELF-ADJOINT ELLIPTIC PARTIAL DIFFERENTIAL EQUATION IN TWO DIMENSIONS. Louis A. Hageman (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-Gen-14. 135p.

An investigation was made to determine whether a cyclically reduced system of equations or the original system may be solved by an iterative method in the most efficient manner. Schröder and Varga used the special form of a 2-cyclic matrix to obtain improvements in the convergence rate for certain point iteration techniques. It is shown that improvements in the rate of convergence may also be obtained for various block iteration techniques and that the cyclic reduction process leads to an efficient method of solution for the two-dimensional self-adjoint second-order elliptic difference equations. A discussion of iterative techniques and the concept of rate of convergence is given. For various block iteration methods, sufficient conditions were obtained which ensure a higher asymptotic rate of convergence for the cyclically reduced system than for the original system. The use of cyclic reduction in the numerical solution of two-dimensional second-order self-adjoint elliptic differential equations is illustrated. (M.C.G.)

25692 (AEC-tr-5139) NEWTON'S POLYGON AND ITS ROLE IN THE PRESENT DEVELOPMENT OF MATHEMATICS. N. G. Chebotarev. Translated by Helen J. Chick and George H. Pimbley (Los Alamos Scientific Lab., N. Mex.) from p.99-126 of "Isaak N'yuton, 1643-1727. Symposium on the 300th Anniversary of His Birth." S. I. Vavilov, ed. (A publication of the Academy of Sciences, Moscow-Leningrad, 1943). 53p.

A survey of results by Newton concerning the Newton polygon is presented. Included are sections on the method of the Newton polygon, theorems relating to the expressions on the polygon, the form in which the method was reported by Newton, development of the method and its generalization, use of the method in study of algebraic curves and equations, role of the polygon in the theory of analytical functions, history of polygon applications, uses of the polygon in the theory of differential equations, p-additive numbers, irreducibility of equations, application of the polygon to the Gallois theory, squared lunes, and algebraic functions and algebraic numbers. (J.R.D.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstract 26479.

25693 (ARL-62-357) RESEARCH ON DISPERSION HARDENING. V. A. Phillips, R. W. Guard, and J. D. Livingston (General Electric Co. Research Lab., Schenectady, N. Y.). May 1962. Contract AF 33(616)-6406. 80p.

The mechanism by which second-phase particles strengthen alloys was investigated. Hardening in age-hardened Ni–Al and Cu–Co alloys was found to be due to the precipitation of coherent ordered Ni_3Al, or Co particles, respectively. Both showed coherency strain fields, but they were particularly clear in the latter. The main contrast effects expected from coherent spherical particles were calculated and found to be consistent with those observed at Co particles. The shape and size of the Co particles agreed with earlier conclusions based on bulk magnetic measurements. Overaging in Cu–Co was found to be partly due to loss of full coherency which is helped by deformation. Particles slightly decreased the spacing of fine slip lines in stretched samples. Dislocations apparently passed through the particles in Ni–Al. Dislocations commonly bowed out between particles indicating local pinning. Particles substantially increased the dislocation density produced by stretching. After 5% strain when the particle size was over about 300 Å, dislocations formed a network with particles at the nodes and in Ni–Al, dislocation tangles formed round each particle. In Ni–Al, particles substantially reduced or even eliminated the temperature dependence of the flow stress. This was first attributed to the elimination of thermally activated cross slip, but electron microscopic observations did not show cross slip to be common in the solid solution. Preliminary observations indicated that the effect of particles on recovery is complex. (auth)

25694 (ASD-TDR-62-272) GROWTH AND ANALYSIS OF ALUMINA "WHISKERS." C. T. Lynch, F. W. Vahldiek, and L. B. Robinson (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). May 1962. 34p.

Alumina whiskers were grown at 1700 to 1800°C in argon and helium atmospheres containing small amounts of hydrogen. Whiskers thus produced were analyzed by x-ray diffraction, spectrographic emission, and wet chemical methods. A scheme was developed for establishing impurity levels in the whiskers. Conditions conducive to growth were investigated, as well as characteristics of whisker growths. Some whiskers which possess unusually complex dendritic growth patterns were examined in considerable detail, and evidence was found of several distinct types of growth forms. A simple tube furnace apparatus for whisker growth is described. (auth)

25695 (BMI-X-188) DEVELOPMENT OF NIOBIUM-BASE ALLOYS FOR USE IN A NUCLEAR SUPERHEATER. Quarterly Progress Report for October–December 1961. John A. DeMastry and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Jan. 1, 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 7p. (EURAEC-271)

Activities are reported in a program to develop Nb-base alloys for use as cladding and/or structural materials which are corrosion resistant to steam at 1000 to 1300°F, and to evaluate their suitability for use in nuclear superheaters. Cr, Mo, Ti, V, and Zr were selected as major alloying additions for study. Alloy compositions are being selected on a fractional factorial design which should allow for statistical analysis. Addition levels for the various elements are listed with hardness data on alloy compositions and impurity content of melting stock. (J.R.D.)

25696 (DRI-2010) THE SCAVENGING OF TUNGSTEN AND MOLYBDENUM WITH SELECTED RARE EARTHS. Quarterly Progress Report No. 2, May 1, 1961–July 31, 1961. C. Samuel Miller and Donald T. Klodt (Denver. Univ. Denver Research Inst.). Aug. 1961. 7p.

Minor additions of yttrium were arc melted with W and Mo to act as scavengers of oxygen and nitrogen and form stable, inert oxides and nitrides. Small-diameter ingots ($\frac{1}{8}$ in.) were melted in a continuous-casting, non-consumable electrode arc furnace using compacted powder charges. The ingots were machined and then formed into rod from which torsion specimens were machined. Recrystallized specimens were tested in torsion at various temperatures and the ductile-to-brittle transition temperature determined. Torsion data for the molybdenum alloys are tabulated. All specimens yielded before fracture, and even a temperature of −190°C was not sufficiently low to bracket the ductile-to-brittle transition temperature for molybdenum. (P.C.H.)

25697 (GEAP-3876) PLUTONIUM FUEL PROCESSING AND FABRICATION FOR FAST CERAMIC REACTORS. E. L. Zebroski, H. W. Alter, and G. D. Collins (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Feb. 1, 1962. Contract AT(04-3)-189. 55p.

A study was made of the processes available for fabrication of plutonium-containing fuel from a fast ceramic reactor, and for chemical reprocessing of irradiated fuel. Radiations from recycled plutonium are evaluated. Adaptation of conventional glove-box handling procedures to the fabrication of recycle plutonium appears practical. It is concluded that acceptable costs are obtainable using moderate extensions of conventional glove-box fabrication methods and wet processing techniques, provided a significant volume of production is available. The minimum economic scale for the preferred chemical reprocessing method, anion exchange, is about 500 Mw(e) of reactor capacity. The minimum scale of economic operation for the fuel refabrication facility corresponds to three 500 Mw(e) reactors, if only steady-state refueling provides the fabrication load. The minimum volume required falls to one 500 Mw(e) reactor, if the continued growth of capacity provides fabrication volume equal to that for refueling. The chemical reprocessing costs obtained range from 0.27 mills/kwh for 1500 Mw(e) of reactor capacity, to 0.10 mills/kwh for 3000 Mw(e) of capacity. The estimated fuel fabrication cost is $211/kg of uranium and plutonium in the core region (excluding axial and radial blankets) or $1.06/g of plutonium content. When axial blankets, fabricated in the same rods, are included; the combined average is $134/kg of uranium and plutonium. Radial blanket fabrication cost is $49/kg of uranium. The overall average of all fuel and blankets is $84/kg of uranium and plutonium. The fabrication cost is 0.29 mills/kwh for a production rate

corresponding to 3000 Mw(e) of capacity (or 1500 Mw(e) of capacity plus growth equivalent to one additional reactor core per year). For one 525 Mw(e) reactor, (plus equivalent growth volume) the fabrication cost becomes 0.42 mills/kwh. (All fuel throughputs are based on fuel life of 100,000 MWD/T.) Using the estimates developed, the total fuel cycle cost for a typical fast reactor design using PuO_2–UO_2 fuel is estimated to be about 0.9 mills/kwh. (auth)

25698 (NP-11636) LA THEORIE DU FRITTAGE. (Sintering Theory). Georges C. Kuczynski (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). June 1960. 110p.

Information on solid phase sintering is critically reviewed. A short account is given of some elementary notions of the thermodynamics of surface phenomena which play an important role in sintering. Various mechanisms leading to agglomeration are considered. It is shown that, in the case of spherical particles of diameter a, the changes in the diameter x of the bridges formed between the particles can be represented as a function of the sintering temperature T and the time t by the general relationship $x^n/a^m = F(T)\,t$, n and m having values depending on the mechanism involved: viscous flow, evaporation followed by condensation, volume or surface diffusion of the substance sintering. It is also established that the second stage of sintering, (densification of the material by shrinkage of the pores) can only occur by viscous flow or volume diffusion. The role of the defects and grain boundaries is very important for these mechanisms. It is shown that the theoretical results are in good agreement with experimental observations. In particular, for the sintering of pure metals and alloys, the phenomena observed can be explained satisfactorily by means of the various mechanisms proposed. The sintering of oxides is also considered: the sintering atmosphere seems to play an important role. Finally, the study of polymer sintering is dealt with briefly. (auth)

25699 (NP-11815) RESEARCH AND DEVELOPMENT OF HIGH TEMPERATURE STRUCTURAL ADHESIVES. Monthly Letter Report No. 5, May 10, 1962 to June 10, 1962. Sven H. Ruetman and Harold H. Levine (Narmco Research and Development. Div. of Telecomputing Corp. San Diego, Calif.). June 10, 1962. Contract NOw 61-0254-c. 5p.

Activities in a program to extend the operating capabilities of adhesives and resins to higher temperatures are described. Antimony thioantimonate as a curing agent for epoxy adhesives yielded bonds with tensile shear strength of 1810 psi at room temperature. Constructive pyrolysis of phenolic resins on glass and carbon cloth were carried out. Data are tabulated. (J.R.D.)

25700 (NYO-10282) ULTRASONIC CLEANING OF ORGANIC MODERATED FUEL ELEMENTS. Bimonthly Progress Report No. 1, April 1 to May 31, 1962. (Aeroprojects Inc., West Chester, Penna.). June 1962. Contract AT(30-1)-3002. 27p.

Heat transfer between fuel and coolant, in the experimental organic reactor (OMRE), is diminished by deposition on the cladding of a film of decomposed coolant (80% organic, 20% inorganic). Thus, the useful life of the fuel is shortened and the chemical reprocessing head-end treatment becomes complicated. The film resists solvent and, in some instances, chemical cleaning. Ultrasonic treatment, having the ability to rupture surface films, offers the possibility of cleaning within the reactor and of increasing the fuel burn-up potential. Range-finding experiments showed that ultrasonic proximity-cleaning at 165°C in Santowax R (the reactor coolant) removes the bulk of the film from simulant fouled cladding specimens. More nearly complete removal was accomplished in four other liquid media at ambient temperature. Cavitation thresholds of candidate cleaning media were explored as one of the possible criteria of solvent selection. (auth)

25701 (WADD-TR-61-64) COATINGS FOR REFRACTORY METALS, FORMED BY ANODIC TREATMENT AND BY VAPOR DEPOSITION. Vernon A. Lamb and John L. Sligh (National Bureau of Standards, Washington, D. C.). July 1961. Contract DO(33(616)-60-2). 24p. (AD-269132)

The preparation of anodic coatings on Nb, Ta, Mo, and W was investigated. The object was to modify such coatings by anodically incorporating elements known to form oxidation protective alloys with these refractory basis metals, and to convert the mixed coatings to a high-temperature oxidation protective film by subsequent reduction and sintering. Anodizing was carried out in both aqueous solutions and in molten salts. Successful coatings were not obtained. Attempts to form aluminide coatings by diffusion of electrodeposited aluminum, followed by anodizing, were also unsuccessful. Efforts were therefore turned to the preparation of coatings by combining electrodeposition and vapor deposition. Specifically, chromium silicide coatings, formed by vapor phase siliciding of electrodeposited chromium, were investigated. Sound coatings were not obtained from hydrogen reduction of $SiCl_4$ due to chemical displacement reaction with the basis chromium. Siliciding with monomethyl and tetramethyl silane avoided the displacement reaction and yielded sound silicon carbide coatings. However, these coatings failed to provide good oxidation protection at 1100°C in air, due to spalling. The differential thermal coefficient of expansion with respect to the basis metal was the probable cause of failure. (auth)

25702 (AEC-tr-5182) METALLOCHEMISTRY AND SOME OF ITS PROBLEMS. I. I. Kornilov (Akademiya Nauk S.S.S.R. Metallurgicheskoi Institut im. A. A. Baikova). Translation of paper for presentation at the International Colloquim "The Impact of Science on Materials Technology," San Carlos de Bariloche, April 2-7, 1962. 71p.

The problems of metallochemistry discussed are investigations of formation of solid solutions between metals and intermetallic compounds, formation of intermetallic compounds of constant and variable composition, and crystallo-chemical reactions in metallic systems in the solid state. Factors which determine the interaction of metals are outlined, including the dimensions of atomic radii of metals, the position of metals in the series of electronegativity of elements, and the valence and character of an interatomic bond of elements. Conditions for the formation of metallic solid solutions are given. (M.C.G.)

25703 (AEC-tr-5216) DEVELOPMENT OF CERAMIC FUELS AND CERAMIC FUEL ELEMENTS IN FRANCE. R. Caillat and J. Stohr. Translated for Oak Ridge National Lab., Tenn. from Atompraxis, 8: 80-6(Mar. 1962). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 15134.

25704 SUSCEPTOR ELEMENTS FOR HIGH TEMPERATURE INDUCTION HEATING. Stephen Hasko and H. S. Parker (National Bureau of Standards, Washington, D. C.). Am. Ceram. Soc. Bull., 41: 467-9(July 15, 1962).

Powdered iridium and tungsten, and sheet tungsten, tantalum, molybdenum, and 80 platinum–20 rhodium alloy were employed in the fabrication of small susceptors for use in inductively heated furnaces. Temperatures up to 2300°C in air and in excess of 2600°C in helium were attained with simple susceptor designs of iridium and tungsten, respectively. The fabrication methods and designs

should be equally applicable to nickel, nichrome, SiC, TaC, $MoSi_2$, and similar refractory metals and compounds. (auth)

25705 PLASTIC ANALYSIS SUPPLEMENTS DESIGN OF ALUMINUM STRUCTURE. Sven H. Wichman and Gordon K. Ahlers (Brookhaven National Lab., Upton, N. Y.). Civil Eng., 31: 60-1(May 1961). (BNL-4932)

Design of the 10-ton Al supporting structure for a criticality assembly experiment for reactor research is discussed. The Al structure supports the 60-ton experimental apparatus, one part of which is stationary, the other part movable. The entire structure and experiment is sheltered by a commercial type grain silo, a prefabricated light gage steel tank, 32 ft in dia. and 41 ft in height. (J.R.D.)

25706 THE PREPARATION OF URANIUM MONOCARBIDE–PLUTONIUM MONOCARBIDE SOLID SOLUTIONS, PLUTONIUM SESQUICARBIDE AND PLUTONIUM MONOCARBIDE. A. E. Ogard, W. C. Pritchard, R. M. Douglass, and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). J. Inorg. & Nuclear Chem., 24: 29-34(Jan. 1962). (In English)

Hypostoicheiometric uranium monocarbide–plutonium monocarbide solid solutions with no impurities detectable by x-ray diffraction or metallographic examination were prepared by sintering at 1450-1850°C mixtures of uranium dioxide, plutonium dioxide, and graphite. Pellets with densities up to 12.85 g/cm^3 (94.5 per cent of theoretical density) were achieved by a second sintering of pressed pellets of the reaction product. By a similar procedure single-phase stoicheiometric plutonium sesquicarbide was prepared with pellet densities up to 12.6 g/cm^3 (99 per cent of theoretical density). However, hypostoicheiometric plutonium monocarbide prepared in the same manner always contained plutonium sesquicarbide as the only impurity. Arc melting of the sintered uranium monocarbide–plutonium monocarbide solid solutions and plutonium sesquicarbide yielded comparably pure materials of near theoretical density. Arc melting of the sintered plutonium monocarbide eliminated the plutonium sesquicarbide impurity resulting in a single-phase hypostoicheiometric plutonium monocarbide. (auth)

25707 NONNUCLEAR USES FOR URANIUM. J. Gordon Parr (Univ. of Alberta). Metal Progr. 82, No. 2: 126 (Aug. 1962).

A review is presented of papers presented at the 1962 meeting of the Canadian Institute of Mining and Metallurgy held in Ottawa on the non-nuclear uses of uranium. The effects of uranium on the properties of steel were studied. Improvement of fatigue and creep properties of steel resulted from additions of uranium. (M.C.G.)

25708 NIOBIUM, TANTALUM, MOLYBDENUM AND TUNGSTEN. REPORT OF A CONFERENCE HELD IN THE UNIVERSITY OF SHEFFIELD, 20th-22nd SEPTEMBER, 1960 AND ORGANIZED BY THE DEPARTMENT OF METALLURGY. A. G. Quarrell, ed. American Elsevier Publishing Co., Inc., New York. 1961. 418p. $16.00.

Thirty-one papers are included on a survey of modern thought on aspects of niobium, molybdenum, tantalum, and tungsten. (N.W.R.)

25709 REACTOR MATERIALS. Technical Progress Review, Vol. 5, No. 2. R. W. Dayton, E. M. Simons, and R. W. Endebrock (Battelle Memorial Inst., Columbus, Ohio). May 1962. 83p. $0.55(GPO) (Domestic), $0.70 (GPO) (Foreign).

Development of reactor materials is reviewed. Topics covered include: fuel and fertile materials, moderator materials, cladding and structural materials, nuclear poisons, and special fabrication techniques. (M.C.G.)

25710 PROCESS FOR DISSOLVING BINARY URANIUM–ZIRCONIUM OR ZIRCONIUM–BASE ALLOYS. Albert A. Jonke, John J. Barghusen, and Norman M. Levitz (to U. S. Atomic Energy Commission). U. S. Patent 3,049,401. Aug. 14, 1962.

A process of dissolving uranium–zirconium and zircaloy alloys, e.g. jackets of fuel elements, with an anhydrous hydrogen fluoride containing from 10 to 32% by weight of hydrogen chloride at between 400 and 450°C., preferably while in contact with a fluidized inert powder, such as calcium fluoride is described. (AEC)

25711 METHOD FOR OBTAINING PLUTONIUM METAL FROM ITS TRICHLORIDE. James G. Reavis, J. A. Leary, and W. J. Maraman (to U. S. Atomic Energy Commission). U. S. Patent 3,049,423. Aug. 14, 1962.

A method was developed for obtaining plutonium metal by direct reduction of plutonium chloride, without the use of a booster, using calcium and lanthamum as a reductant, the said reduction being carried out at temperature in the range of 700 to 850°C and at about atmospheric pressure. (AEC)

Corrosion

Refer also to abstract 26475.

25712 (AGN-8051) RUBIDIUM CORROSION CAPSULE PROGRAM. Quarterly Technical Report, November 1, 1961–January 1962. Report No. 4. Robert V. Arabian (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AT(04-3)-368. 9p.

Tests are being carried out to obtain corrosion and solubility data on various containment materials for rubidium at temperatures from 1000 to 2000°F. Progress is reported on corrosion and solubility test runs, test analysis, and analytical procedures. (M.C.G.)

25713 (BMI-1563) CORROSION OF THORIUM AND URANIUM DURING LONG-TERM STORAGE. Elmer F. Stephan, Paul D. Miller, and Frederick W. Fink (Battelle Memorial Inst., Columbus, Ohio). Jan. 24, 1962. Contract W-7405-eng-92. 32p.

Thorium, uranium, and uranium-10 wt % molybdenum alloy, bare and organic- or metal-coated coupons, and composite assemblies, joined by soldering, welding, or machine screws, were evaluated for corrosion behavior during storage for at least 1 year uncovered and in loosely covered metal containers under ambient conditions in a waterfront building at Daytona Beach, Florida, in an unheated warehouse, and on a rooftop at Columbus, Ohio. In general, the samples exposed at the Florida site exhibited slightly more attack, but in no case was severe corrosion encountered. The uranium-10 wt % molybdenum alloy was most durable, displaying a relatively uniform tarnish film. Thorium samples darkened and exhibited some nodular growth along with white corrosion products at isolated areas. Uranium samples also darkened, and some were covered with black nodules. Random pits, up to 1.6 mils deep, were detected on uranium samples. There was no indication of crevice or galvanic-couple corrosion in any of the dissimilar metal combinations studied. Of the protective coatings, nickel coatings on thorium were found to be very resistant to corrosion. Vinyl-type coatings blistered on uranium, but not on thorium. Aluminum coatings blistered on uranium. It was concluded that protective

coatings would be required to insure complete protection of thorium and uranium. (auth)

25714 (DMIC-169) THE EFFECT OF MOLTEN ALKALI METALS ON CONTAINMENT METALS AND ALLOYS AT HIGH TEMPERATURES. M. F. Amateau (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). May 28, 1962. Contract AF33(616)-7747. 54p.

A review is given on the corrosive effects of molten alkali metals on high temperature materials, and conclusions are drawn from existing data. Most of the high-temperature engineering metals such as refractory metals, nickel-base and cobalt-base superalloys, and the austenitic and ferritic stainless steels are sufficiently resistant to liquid sodium and NaK to be useful up to about 1600°F. The refractory metals and alloys are particularly susceptible to attack by sodium containing excessive amounts of oxygen. No material is truly corrosion resistant to Li, although the refractory metals Ta, Nb, and Mo do have some potential for high-temperature service in engineering applications. The nitrogen content of the Li is a particularly important factor in its corrosive effects. K, Rb, and Cs are somewhat less corrosive than the other alkali metals. The refractory metals and alloys are little affected by these liquid metals. Na and K can cause degradation of mechanical properties of containment materials, depending on the amount of oxygen and nitrogen found in the respective liquid metals. Also, the sliding and bearing properties of metals are generally affected adversely by the presence of pure molten metals. (P.C.H.)

25715 (KR-14) DESCRIPTION OF THE I.F.A. CORROSION LOOP I. K. Videm (Norway. Institutt for Atomenergi, Kjeller). Jan. 1962. 20p.

The IFA out-of-pile corrosion loop I is basically a closed circuit of 80-mm ID pipes with a pump. The 80-mm pipes serve as test sections, the two longest being 2.8 m. The pump is of conventional design with a shaft passing through a stuffing box. A mixed bed ion exchanger in a bypass circuit is used for water purification, and autoclaves for exposures at low flow rates are included in the circuit ahead and after the ion exchanger. All parts in contact with water are made of type 347 stainless steel. Maximum operational pressure and temperature are 35 kg/cm^2 and 235°C, respectively. (auth)

25716 (NP-11876) OXIDE NUCLEATION AND GROWTH (thesis). Technical Report No. 5. William Harold Orr (Cornell Univ., Ithaca, N. Y.). Apr. 1, 1962. Contract Nonr-401(31). 186p.

Although the interaction of oxygen with a clean metal surface is usually interpreted in terms of homogeneous chemisorption, careful kinetic measurements of the very initial takeup of oxygen by a clean magnesium surface indicate that the first stage of the process is dominated by nucleation and growth of the oxide phase at certain preferred sites on the metal surface. This interpretation is supported by the observed structure of the oxide film. Clean magnesium surfaces were formed by deposition in ultra-high vacuum at temperatures of 86 to 304°K. The Wagener flow method was used to study the kinetics of oxide film formation at very low oxygen pressures in the temperature range of 77 to 304°K. By careful characterization of the pumping action of the ionization gauges, reliable kinetic data were obtained for the region of very low surface coverages starting at a point where the surface had taken up only 3×10^{12} oxygen molecules per cm^2. Measurements were continued until an oxide film more than five monolayers thick was formed. The structures of the metal surface and oxide film were studied by electron microscopy and electron diffraction. The oxidation process can be considered to occur in two stages, the first being nucleation and lateral growth of the oxide film and the second being growth of the film normal to the surface. During the first stage the sticking probability S increased with takeup of oxygen w according to the relationship $S = Aw^{-\frac{1}{2}}$. This relationship was derived and the constant A evaluated for an oxide island growth model. It was assumed that each island had an active zone at its edge, the effective width of which was calculated in terms of the fundamental processes of adsorption surface diffusion and capture of the oxygen molecules. From the very small temperature dependence of S, the width was estimated to be about 11 Å. The density of oxide islands was calculated to be about 2×10^{11} islands/cm^2. Dark field electron micrographs of the oxide film showed that it was made up of small oxide grains with a density of about 8×10^{11} grains/cm^2. Once the oxide islands had grown together the sticking probability decreased as the oxide film thickened according to the relationship $S = A_B \exp[(E_B - E_b w)/RT]$ where $E_B = 7 \pm 3$ kcal/mole and $E_b = 1.6 \pm 0.3$ kcal/mole/monolayer. During both stages of the oxidation process the sticking probability was independent of the oxygen pressure. (auth)

25717 (NP-11948) STRESS CORROSION OF HIGH STRENGTH STEELS AND ALLOYS; ARTIFICIAL ENVIRONMENT. Final Report. (Mellon Inst., Pittsburgh). 1962. Contract DA-36-034-ORD-3277RD. 121p.

The susceptibility of various high strength missile materials to stress corrosion cracking in a number of synthetic environments was studied. High strength steels and alloys investigated included D6Ac, 300M, Vascojet-1000, AM355, PH15-7Mo, B120VCA, 4137Co, Ardeform 301, and Racoloy 270. Test data on mechanical properties and stress corrosion, and chemical analyses, as-received mechanical properties, heat treating surveys, and heat treatment methods are given. Cumulative bent beam and U-bend stress corrosion test data, decarburization and alloy modification effects on stress corrosion susceptibility, and the contribution of various organic coating variables to the alleviation of stress corrosion failure are also presented. In general all low alloy martensitic steels showed a susceptibility to stress corrosion failure in varying degrees. A decarburized surface was found to decrease failure rate in U-bends by several orders of magnitude and alloying with uranium effected a U-bend failure rate decrease of well over one order of magnitude. Organic coatings were not too effective in inhibiting stress corrosion failure, one or two coatings being somewhat superior to the others. The more promising combinations of coating variables are indicated. (auth)

25718 (NP-11952) AN INVESTIGATION OF THE CORROSION RESISTANCE OF METALLIC MATERIALS TO MOLTEN LITHIUM HYDRIDE AT CYCLIC ELEVATED TEMPERATURES. E. J. Vargo and D. B. Cooper (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Feb. 14, 1962. Contract NAS 5-462. 158p. (ER 4774).

The corrosive effects of LiH, Li, and mixtures of LiH and Li on various structural metals were investigated. The materials included Fe, Ni, Co, and refractory base alloys as well as unalloyed Mo and Ti in the form of tubing. The tests were conducted in air, argon, and hydrogen atmospheres for periods up to 3008 hr and were either conducted at static temperatures of 1500 or 1600°F or were cycled between 1165 and 1600°F. Based on single metal capsule results, the materials were classified into three groups dependent on the depth of corrosive attack as indicated by

metallographic examination. AISI 1010 and Mo (containing no more than 0.005% C) were indicated to be superior to the other materials. It was indicated that the other materials would suffer a corrosive attack which would penetrate to a depth of more than 5 mils in 10000 hr. The presence of two or more dissimilar metals in a capsule in some cases caused increased corrosion activity. It was revealed that the problem of containing hydrogen and thus halting the dissociation of LiH, $2LiH \rightarrow 2Li + H_2$ would be formidable. Various hydrogen barrier coatings were tested, but only glass and aluminum oxide proved to have any merit. (P.C.H.)

25719 (FTD-TT-61-31) INVESTIGATIONS OF HEAT RESISTANT ALLOYS. Transactions 123. (Selected Articles). (Issledovaniya Zharoprochnykh Splavov. Trudy 123). Translated from a publication of the State Scientific Technical Publishing House of Defense Literature, Moscow, 1960. 69p.

Four papers on heat resistant alloys are presented. Topics covered include selective alloying as a method for improving heat resistance, investigation of the dependence of the structure and properties of gas turbine blades on the duration of operations, strength of alloys in contact with sodium, and high temperature corrosion resistance. Separate abstracts were prepared for two papers. (M.C.G.)

25720 (FTD-TT-61-31(p.41-59)) STRENGTH OF ALLOYS IN CONTACT WITH SODIUM. S. T. Kishkin and G. P. Benediktova. (Translation)

The mechanical strength of a number of alloys operating in contact with sodium at high temperatures was investigated. Short-term and long-term tests were carried out with hollow, sodium-filled steel specimens. Results of short term tests at 1000°C showed that sodium-filled samples yield a negligible increase in ultimate strength and a decrease in the plasticity of the alloys. According to long-term test data the limit of long-time strength of the alloys remained the same or increased. (M.C.G.)

25721 (FTD-TT-61-31(p.60-9)) HIGH-TEMPERATURE CORROSION RESISTANCE. (Translation)

Investigations of high-temperature corrosion resistance in oxidizing medium of silt furnaces at 1100°C, conducted for 120 hr with various steels, showed a considerable increase in high-temperature corrosion resistance of chromized alloys. Long-time corrosion resistance after chromizing was also observed in iron. Siliconizing made it possible to impart a high-temperature corrosion resistance to such metals as tungsten, molybdenum, niobium, etc. Surface saturation of steels with aluminum also improved high-temperature corrosion resistance. (M.C.G.)

25722 (UCRL-Trans-830) A VOLUME EFFECT BY CORROSION OF SILICON SINGLE CRYSTALS. Hansjochen Benda. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Z. Naturforsch., 13a: 354-5(1958). 4p.

During corrosion of high-ohmic single crystals of p-silicon, an unexpected setback of creep life was observed which indicated a volume effect of corrosion. (M.C.G.)

25723 OXIDATION OF BERYLLIUM INTERMETALLIC COMPOUNDS IN MOIST ATMOSPHERES. E. A. Aitken and J. P. Smith (General Electric Co., Cincinnati). J. Nuclear Materials, 6: 119(May-June 1962). (In English)

It was found that intermetallic compounds of beryllium undergo attack by moisture in an intermediate temperature range. These intermetallic compounds react with moisture-containing atmospheres at a relatively high rate at 1000 to 1800°F. (M.C.G.)

25724 PROTECTION OF BERYLLIUM METAL BY ANODIC FILMS. L. J. Vachon (Nuclear Metals, Inc., Concord, Mass.). J. Nuclear Materials, 6: 139-41(May-June 1962). (In English)

A preliminary study was undertaken to find a means to prevent or retard beryllium interaction with UO_2 and corrosion by CO_2. It was found that a beryllium wafer anodized to form a thin film covering of BeO did not interact with uranium and offered good corrosion resistance to CO_2. (M.C.G.)

25725 THE OXIDATION OF BERYLLIUM. W. B. Jepson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Research (London), 15: 288-94(July 1962).

One of the problems associated with the use of beryllium in a gas-cooled reactor is that of its compatibility with the coolant gas. Available information on the oxidation of beryllium (at temperatures upwards of 500°C) in oxygen and in carbon dioxide, with and without the presence of water vapor, is summarized and discussed in terms of current theories. Progress in the development of material which is able to withstand the deleterious effect of water vapor is outlined. (auth)

25726 INVESTIGATION OF THE EFFECTS OF FABRICATION VARIABLES ON THE CORROSION RESISTANCE OF ZIRCALOY-2. Herbert S. Kalish and Harold M. Cobb (United Nuclear Corp., New Haven, Conn.). Trans. Am. Soc. Metals, 54: 247-59(Sept. 1961).

A comprehensive investigation was conducted of the effect of melting and fabrication variables on the corrosion resistance of Zircaloy-2 in 750°F steam at 1,500 psi. Two 12-in. diameter production-type ingots and three 4-in. diameter laboratory-type ingots were produced, representing primary and secondary melting in 75% helium-25% argon atmosphere, primary melting in 75% helium-25% argon and secondary melting in vacuum, and primary and secondary melting in vacuum. Variations were made in the ingot forging procedures, hot rolling temperatures, homogenization treatment, and final heat treatment of the hot rolled Zircaloy-2 strip. Corrosion data were obtained on the strip produced from the large ingots after 14, 28, 56, 70, 84, and 112-day intervals. Corrosion data were obtained on strip produced from the small ingots at 14 and 28-day intervals. The weight-gain data were statistically analyzed. The major findings include the fact that 1900°F heat treatment followed by a slow cool resulted in detrimental corrosion resistance, regardless of fabrication and melting technique. It was also found that secondary vacuum melting resulted in a more corrosion-resistant Zircaloy-2 strip than that produced from secondary atmosphere melted material. It was found that there was no advantage in a primary inert atmosphere and secondary vacuum melt over a double vacuum melt. It appeared that minimizing reheat and/or conditioning operations during forging was beneficial to the corrosion resistance. Rolling temperature in the range of 1450 to 1675°F and homogenization treatment seemed to have little significant effect from a practical standpoint on the corrosion resistance of Zircaloy-2. It was found, however, that Zircaloy-2 corrosion in 750°F steam is statistically significantly affected by almost any change in fabrication variables. Most of these factors, except those outlined, however, appear to be too small to be of practical significance. (auth)

25727 KINETICS OF OXIDATION OF LITHIUM. E. F. McFarlane and F. C. Tompkins (Imperial Coll., London). Trans. Faraday Soc., 58: 1177-86(June 1962).

The kinetics of oxidation of sintered evaporated lithium films was studied over the temperature range 78-300°K

at low pressures of oxygen ($\sim 10^{-4}$ to 10^{-2} mm Hg). Both the direct and inverse logarithmic equations give reasonable representations of the kinetics, but the linear decrease of activation energy with the inverse thickness of oxide layer and the existence, for given temperatures, of a critical thickness, above which oxidation virtually ceases, are consistent with the Mott-Cabrera theory for films of less than 50 Å thick. The rate depends, at constant thickness and temperature, on the square root of the oxygen pressure and a mechanism similar to that suggested for the low-temperature oxidation of germanium. The most interesting feature of the oxidation of lithium is the presence of a breakaway phenomenon at a specific temperature below the predicted critical temperature and at a critical thickness of about 14 layers of oxide. This corresponds to a stripping process, since all the kinetic and energetic features of the oxidation on the initially clean film can be reproduced quantitatively over the range of thickness studied. (auth)

Fabrication

25728 (AD-270153) FABRICATION OF PYROLYTIC GRAPHITE ROCKET NOZZLE COMPONENTS. Final Report. D. J. Shipp (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 30, 1961. Contract NOw 61-0161-c (FBM). 106p. (DM-62-15)

Pyrolytic graphite is produced by the degradation of a hydrocarbon vapor either by the thermal energy it receives from its proximity to a hot surface or by impingement onto that hot surface. A wide range of environmental conditions can be used to produce the material with the resulting physical properties being a function of the particular environmental conditions employed. In depositing pyrolytic graphite onto a substrate, the substrate is loaded into the susceptor and the chamber is evacuated to an absolute pressure of 1 mm Hg or less, the substrate is heated to the desired temperature. The hydrocarbon vapor is then passed through and/or around the substrate with gaseous reaction by-products being exhausted with vacuum pumps, and after sufficient time elapses for formation of the required amount of pyrolytic graphite the flow of reaction gas is stopped. The pyrolytic graphite coated substrate is allowed to cool slowly to room temperature, after which it is removed to undergo subsequent operations. (auth)

25729 (ASD-TR-7-785(VI)) MOLYBDENUM ALLOY EXTRUSION DEVELOPMENT PROGRAM. Sixth Interim Technical Engineering Report, February 15, 1962–June 1, 1962. P. A. Santoli (Allegheny Ludlum Steel Corp. Research Center, Brackenridge, Penna.). July 1962. Contract AF 33(600)-40861. 46p.

Five full length T shape extrusions of TZM were made from 3200°F with a reduction ratio of about 19:1. High liner pressure in excess of 200,000 psi at an initial stem speed of 100 inches per minute was required to accomplish the extrusions within reasonable run-out of dimensions. One full length extrusion was within size requirements. Surface quality of full length extrusions was fair being characterized by localized glass or die coating rub-in and striations. The extrusions were accomplished with zirconia coated dies applied by Source D using the oxyacetylene flame-spray process with solid-rod feed. Die performance was improved by more careful application of the coating followed by a thorough inspection with suitable gages. (auth)

25730 (ASD-TR-62-7-647) BERYLLIUM FORGING PROGRAM. Final Technical Engineering Report, May 6, 1958–November 19, 1961. A. F. Hayes and J. A. Yoblin (Ladish Co., Wis.). June 1962. Contract AF33(600)-36796. 305p.

Unclad vacuum hot pressed beryllium was successfully forged in closed dies to provide an improved aerospace quality structural material for Air Force requirements. The expendable, hot steel support technique was successfully used to drastically deform unclad beryllium in trial production runs. A mild amount of unrestrained deformation can be imposed on billets of relatively small size. Forged beryllium shows a significant increase in mechanical properties over those reported for hot-pressed beryllium. Three of six shapes investigated were successfully and reproducibly completed after adequate development of tooling and forging sequences for each specific shape. The production runs for the initial forging operations of the other three shapes were also successful; however, ring rolling and forming techniques were only partially successful. A comprehensive mechanical properties evaluation, including tensile, compression, shear, fatigue, creep rupture, and impact tests, demonstrated that significantly improved properties in the plane or direction of metal flow can be achieved through forging. Transverse tensile properties were lower than longitudinal properties with the difference being dependent upon the amount of work. Development of the forging process for beryllium was based upon results of an investigation of forging variables. A series of 144 beryllium samples, comprising both hot-pressed and arc-cast types of beryllium, were encased in ½-inch thick steel jackets and upset forged to determine a preferred material, method of deformation (press or hammer), and forging temperature. Press forging hot-pressed beryllium at a temperature of 1375°F produced the highest quality forgings from the standpoint of soundness and mechanical properties. (auth)

25731 (GA-2241) APPARATUS AND PROCEDURE FOR COATING THORIUM–URANIUM CARBIDES WITH CARBON AT 1000° TO 1400°C. C. S. Luby (General Atomic Div. General Dynamics Corp., San Diego, Calif.). May 25, 1961. Contract AT(04-3)-314. 6p.

The apparatus and coating procedures, developed to a point where satisfactory coated carbides can be produced on a laboratory-scale basis, are described. A typical coating run is described. The principle of the coating process is to levitate $(Th,U)C_2$ particles as a fluid bed in a jet stream of helium, heat the particles to 1000 to 1400°C, and introduce a partial pressure of hydrocarbon gas. The hydrocarbon gas is dissociated to carbon and hydrogen, with a large percentage of the carbon being deposited on the particles. The resultant product is a $(Th,U)C_2$ particle coated with a fairly dense layer of pyrolytic carbon. (P.C.H.)

25732 (GNEC-197) DEVELOPMENT OF THE BONUS TYPE SUPERHEATER FUEL ASSEMBLY. Terminal Report under Activity No. 40-00-00, Structural Restraint of Fuel Elements. (General Nuclear Engineering Corp., Dunedin, Fla.). Oct. 31, 1961. Contract AT(11-1)-795. 212p.

Fabrication techniques were developed for component manufacturing and assembly of BONUS-type superheater fuel assemblies. Methods are described for collapsing the fuel cladding, centering the fuel rod within the coolant tube, centering the coolant tube within the pressure tube, attaching the pressure tubes to the tube sheets, intermediate support of pressure tubes, component fabrication, and fabrication and assembly of the prototype fuel assembly. The techniques were used to satisfactorily produce one gen-

erally acceptable prototype BONUS superheater fuel assembly. (M.C.G.)

25733 (MAB-139-M(F4)) STATE OF THE ART ON FORGING AND EXTRUSION. Progress Report No. 4. (National Research Council. Materials Advisory Board). May 14, 1962. 59p.

A review is given of developments under way or anticipated which will advance the state of the art of forging and extrusion for the period 1965 to 1980. (P.C.H.)

25734 (NAA-SR-7293) FABRICATION OF CERAMIC INTERNAL REFLECTOR FOR THE SNAP 8 EXPERIMENTAL REACTOR. K. Langrod (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). July 15, 1962. Contract AT(11-1)-GEN-8. 37p.

Fabrication of internal reflector pieces for the SNAP-8 core is described. These reflectors were made of BeO, with and without the addition of Sm_2O_3 as a nuclear poison. Because of the high density and dimensional tolerance requirements, the complexity of shapes, and the comparatively modest number of parts to be produced (approximately 1000), the blanks were hot pressed and subsequently machined with diamond wheels and cores. In almost all cases, the specified density of 98% of theoretical was achieved. The low eutectic temperature in the $BeO-Sm_2O_3$ system of about 1420°C necessitated special pressing parameters, which were arrived at by experimentation. A rather coarse grit size (80) was used for the diamond wheels, which resulted in very little wear to the wheels, and an extremely low dimensional rejection rate on the blanks. Because of the toxicity of BeO, all equipment was enclosed, and was held under negative pressure. (auth)

25735 (NMI-7251) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period May 1, 1962–May 31, 1962. S. Isserow, R. W. Anderson, W. J. Richmond, and D. M. Davies (Nuclear Metals, Inc., Concord, Mass.). June 26, 1962. Contract [AT(30-1)-1565]. 32p.

Two outer tubes containing U–1 wt % Si and U–1.5 wt % Mo cores are being fabricated for irradiation in the HWCTR. The U–1 wt % Si tube was successfully beta treated and air cooled, and is undergoing nondestructive testing. The U–1.5 wt % Mo tube remains in the as-extruded condition pending selection of a heat treatment. The hot hardness data for the dispersion hardenable U–0.035 wt % Fe–0.09 wt % Al alloy after aging treatments at 400, 500, and 600°C showed that the allow is consistently harder than unalloyed U at test temperatures to 600°C, and that oil quenching from the beta phase results in a dispersion hardened condition. It was also found that the hardnesses of the alloy can be moderately increased by aging (at 400°C) after beta quenching, and that softening of the alloy (overaging) can occur at 500 and 600°C; the rate of softening is about one hundred times more rapid at 600°C. Modifying the U–Fe–Al alloy with additions of Si and Cr increases the hardnesses to 600°C moderately. The precipitated particles are smaller and less concentrated than in the U–Fe–Al. Evaluation of a very dilute alloy containing about 500 ppm total of Fe, Ni, Si, and Zr showed that the hardnesses in the 200 to 500°C range are susceptible to heat treatment. Heat treatments necessary to develop the properties are similar to those used to develop the "delta phase" for control of grain size. Studies of cast 0.15, 0.4, 1.0, and 1.5 wt % Mo alloys before and after heat treatment for 100 hours at 540°C indicated that the hardness behavior of these alloys can be related to phase transformations deduced from the phase diagram and metallographic data. It was also shown that the 1.5 wt % Mo alloy exhibited the greatest microstructural and hardness stability at 540°C, and the hardness transition temperature of approximately 500°C is apparently a stable condition. The solubility limit of Mo in U was found to be less than 0.15 wt % at 540°C. Twelve specimens containing U–0.035 wt % Fe–0.09 wt % Al cores are being prepared for irradiation at SRP in lead-insulated capsules. A prototype tube was successfully extruded. In the extrusion of this tube and of core stock for the irradiation specimens, the metallurgical condition of the alloy markedly affected the extrusion constant. (auth)

25736 (NUMEC-P-100) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Progress Report for Period January 1 through March 31, 1962. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2389. 69p.

During this reporting period, particular effort was placed on powder blending and pellet sintering studies prior to irradiation sample fabrication, and, subsequently, the production and characterization of the pellets slated for irradiation. Also, PuO_2 and UO_2-PuO_2 characterization studies were continued, and new techniques are being developed. Specifically, dynamic moisture pickup determinations on PuO_2 were made in moist air, N, and CO_2 atmospheres using a recording thermogravimetric balance; the Sharples Micromerograph was committed to Pu, and powder particle size distributions were measured and compared with previous determinations made with air-permeability equipment; and the suitability and reliability of analytical chemistry assaying procedures such as x-ray-fluorescence and gamma spectrometry are being evaluated. Prototype work on UO_2 for the direct precipitation of PuO_2 and PuO_2-UO_2 feed materials for swaging, vibratory compaction, and dispersion fabrication was also continued. In addition, investigation of PuO_2 spherical particle formation by mechanical buildup and by plasma torch fusion was extended. Associated reactor physics studies were concentrated on the further comparison of Pu and U^{235} in near-thermal converter reactors. In preparation for the fabrication of irradiation test specimens to be prepared by the mechanical blending of individual PuO_2 and UO_2 powders, blending studies were initiated to develop methods required for the attainment of desired homogeneity. Sintering studies were carried out on PuO_2 to study the effects of compaction pressure, firing temperature, firing time, and firing atmosphere. It was determined that 1400 to 1500°C is the best firing temperature to obtain maximum pellet density, and that sintering in air yields higher densities than sintering in a N_2-H_2 atmosphere. Further, it was noted that the degree of Pu_2O_3 formation while sintering in an N_2-H_2 atmosphere is inversely proportional to compaction pressure, indicating that the degree of formation is determined by the exposed surface area. Two additional lots of UO_2-5 wt % PuO_2 powder were precipitated during this period. Powder characterization data for these and two previously produced lots were obtained. Also, powder characteristics were remeasured following hammermilling in order to allow assessment of the effects of this treatment. In preparation for work with PuO_2 and UO_2-PuO_2, prototype studies are being carried out with UO_2 to assess the possibility of producing directly high density granular feed for swaging, vibratory compaction, and dispersion fuel fabrication. Effort was continued on the fabrication of spherical PuO_2 particles by mechanical buildup and by plasma torch fusion. Reactor physics studies were continued to allow assessment of Pu relative to U^{235} in near-thermal reactor sys-

tems. Under cost assumptions used previously, it was shown that optimum fuel cycle costs from Pu-natural U fueled systems are well below those attainable with slightly enriched U fueled systems even if it is assumed that radiation damage is not limiting and that an ideal burnable poison (or solution poison) exists to limit the reactivity. (auth)

25737 (WAL-TR-460.54/1-2) JOINING OF REFRACTORY METALS—TUNGSTEN. Final Report. J. H. Brophy, H. Heidekiang, P. Kovach, and J. Wulff (Massachusetts Inst. of Tech., Cambridge). Mar. 30, 1962. Contract DA-19-020-ORD-5236. 68p.

Concepts of activated tungsten diffusion were applied to the joining of tungsten strip at temperatures ranging from 900 to 1100°C. Solid state diffusion was enhanced by electroplating a thin layer of either nickel or palladium on one of the mating surfaces. Assemblies were made by heat treating in a high temperature vise or by spot welding followed by a diffusion treatment. Joints were in sandwich, single-lap, or double-lap geometries. Fractography, metallographic examination, bend tests, and tensile shear loading tests indicated that bonding could be accomplished at temperatures as low as 1000°C. The structure was typically partially recrystallized but free of thermal cracks. The joints were brittle at room temperature, but specimens heated to 2200°C remained capable of bearing a load. A brief theoretical discussion and an interpretation in the light of other joining techniques were offered. (auth)

25738 THE CHEMICAL POLISHING OF RARE EARTH TELLURIDES. P. Bro (Avco Corp., Wilmington, Mass.). J. Electrochem. Soc., 109: 750(Aug. 1962).

A variety of chemical etches for rare earth tellurides was investigated. The main problem was finding a reactive medium that could dissolve the metal and the tellurium at comparable rates to produce a polished surface. A satisfactory chemical polish was found for sesqui- and higher tellurides. It consisted of 10 ml glacial acetic acid and 1 ml bromine. (M.C.G.)

25739 BRAZING BERYLLIUM OXIDE TO PYROLYTIC GRAPHITE. K. K. Ikeuye (Advanced Materials and Processes, Inc., Los Altos, Calif.) and G. R. Grow. Welding J. (N. Y.), 41: 346S-9S(Aug. 1962).

Three brazing alloys which will successfully wet and bond to both BeO and pyrolytic graphite were developed: 93 Ti–7 Ni, 93 Ti–7 Fe, and 53 Ti–47 Cr. Ordinary brazing techniques employing vacuum or inert atmospheres are suitable for effecting BeO-to-pyrolytic graphite bonds with the three brazing alloys. The large differential in thermal expansion between BeO and pyrolytic graphite in the "a" direction resulted in high residual stresses in the brazed joint, and these residual stresses are sufficiently large in many instances to crack either or both of the base material components. Joint designs were developed which will prevent cracking in small (up to ⅛-in. long) joints, but these designs will not prevent cracking of one or the other of the base materials in longer joints. (auth)

25740 NEW DEVELOPMENTS IN GAS SHIELDED ARC WELDING OF BOILER AND NUCLEAR COMPONENTS. F. W. Armstrong (Babcock & Wilcox Co., Barberton, Ohio). Welding J. (N. Y.), 41: 713-18(Aug. 1962).

Gas shielded-arc welding methods are described. Uses in fabrication of boiler and nuclear components are discussed. Requirements for tungsten-arc surfacing are outlined including travel speed control, electrode configuration, cold wire settings, and cold wire selection. A program initiated to test each heat of wire on mock-ups of production test pieces is described. (M.C.G.)

25741 ABSTRACTS OF TECHNICAL PAPERS PRESENTED AT AWS 43rd ANNUAL MEETING AND ASME METALS ENGINEERING CONFERENCE, APRIL 9-13, 1962, HOTEL SHERATON-CLEVELAND, CLEVELAND, OHIO. 104p. $2.00(American Welding Society, N. Y.).

Seventy-two abstracts of papers presented at American Welding Society 43rd annual meeting and ASME Metals Engineering Conference are given. Topics covered include: processes, gas-shielded arc welding, brittle fracture, metallurgical aspects of fracture, structure and weld evaluation, filler metals, steels and titanium, repeated loading, cutting, resistance welding, creep, heat exchangers and pressure vessels, aircraft and missiles, weld properties and applications, beryllium, aluminum and magnesium, special processes, brazing, piping, and nuclear and other materials. (M.C.G.)

25742 CARBON ARTICLES. William Johnson and William Watt (to United Kingdom Atomic Energy Authority). British Patent 901,847. July 25, 1962.

A process is given for improving the impermeability of a porous carbon article. The process comprises impregnating the article, resinifying the impregnant in the pores, and carbonizing the impregnant by heating the articles under non-oxidizing conditions. The impregnant constitutes furfuryl alcohol with finely divided carbon as filler. Hollow or complex carbon articles may be treated by carrying out the process on one face and then repeating the process on the other face. Several examples of the process are given. (D.L.C.)

25743 PROCESS FOR MANUFACTURING CARBON ARTICLES. William Johnson, William Watt, and Michael Stuart Thomas Price (to United Kingdom Atomic Energy Authority). British Patent 901,848. July 25, 1962.

A process is given for manufacturing carbon or graphite articles with low porosity and gas permeability. The process comprises mixing carbon or graphite powder with a liquid furan derivative as binder, shaping the mixture, polymerizing the binder, and carbonizing the binder. The binder may be furfuryl alcohol. Articles produced in this way have an apparent density of ~1.8 g/cm^3 and a Darcy gas permeability of 10^{-13} cm^2 or less. Several examples of the process are given. (D.L.C.)

Properties and Structure

Refer also to abstracts 25402, 25660, 25720, 26474, 26476, 26481, 26482, 26483, 26484, 26488, and 26[illegible].

25744 (AD-269196) MATERIALS PROPERTY DATA. Phase I—Quarterly Progress Report No. 3, October 1, 1961–December 31, 1961. James W. Yates (Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.). Jan. 1962. Contract AF33(616)-8086. 127p.

Data and information are presented which were collected in a program to review and compile previously unreported materials property data. The data are related to high-friction and rocket motor materials. The high-friction materials data are on aircraft brake linings. The rocket motor data are on materials for throats, nozzles, and insulation. (J.R.D.)

25745 (AECL-1529) HIGH TEMPERATURE PROPERTIES OF CERAMIC FUELS: THEIR SIGNIFICANCE AND MEASUREMENT. J. A. L. Robertson (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1962. 27p.

The properties of ceramic fuels that potentially influence

the sheath's stability and that reveal or determine the temperature distribution are reviewed. Experimental methods of measuring these properties and their limitations are discussed. (M.C.G.)

25746 (ARF-2230-9) DELAYED FAILURE HYDROGEN EMBRITTLEMENT OF ZIRCONIUM. Quarterly Report No. 3, March 15, 1962–June 14, 1962. D. Weinstein and F. C. Holtz (Illinois. Inst. of Tech., Chicago. Armour Research Foundation). July 6, 1962. Contract AT(11-1)-578. 18p.

An investigation was made to determine the extent to which zirconium and zirconium alloys exhibit delayed failure (static fatigue) as caused by a combination of absorbed hydrogen and applied stress. Evaluation of susceptibility to time-dependent fracture was performed on an experimental Zr–Al–Sn–Mo alloy containing 500 ppm hydrogen and the Canadian Zr–2.5Nb cladding material, as well as unalloyed zirconium and Zircaloy-2. For unalloyed zirconium and Zircaloy-2 containing up to 500 ppm hydrogen, no time-dependent fracture was observed which could be attributed to the delayed failure phenomenon; an increased grain size or 20% prior reduction by cold rolling did not significantly affect this behavior. The curve of applied stress versus time to failure for the high-strength Zr–Al–Sn–Mo alloy containing 500 ppm hydrogen indicated susceptibility to time-dependent fracture due to hydrogen absorption. Short-time data for Zr–2.5Nb in the heat-treated condition and containing 500 ppm hydrogen indicated that this material is insensitive to delayed failure. (auth)

25747 (ASD-TDR-62-204(Pt.I)) THERMODYNAMIC AND KINETIC STUDIES FOR A REFRACTORY MATERIALS PROGRAM. (Little (Arthur D.) Inc. Western Div., San Francisco). Jan. 1962. Contract AF33(616)-7472. 85p.

Studies developed to provide thermodynamic and kinetic knowledge needed to describe the chemical behavior of zirconium and hafnium carbides and borides at temperatures to 3000°K and in atmospheres of O_2, $O_2 + H_2O$, Cl_2, HF, F_2, H_2, CO, NH_3, and N_2 are summarized. The studies consist of thermodynamic data for the tabulation of free energy functions of the zirconium and hafnium carbides and borides through calorimetric measurements; identification of gaseous species formed on vaporization of the carbides and borides and on their interaction with the several atmospheres by mass spectrometry; thermodynamic data for important gaseous species by electron diffraction techniques, matrix isolation spectroscopy, and equilibria studies; and development of kinetics of the reactions of the carbides and borides with the various atmospheres through studies of the over-all rates of reactions and mass transport mechanisms. The status of each is discussed in detail. The preparation and characterization of macrocrystalline, high purity ZrB_2 and ZrC are described. Low temperature heat capacity data for ZrB_2 and heat content data for ZrB_2, ZrC, and HfB_2 are presented. The results of a study of the vaporization of ZrB_2 are also reported. (auth)

25748 (ASD-TDR-62-476) INVESTIGATION OF THE EFFECTS OF PROCESSING VARIABLES AND FABRICATION TECHNIQUES UPON THE PROPERTIES OF INTERMETALLIC COMPOUNDS. Richard S. Truesdale, Byron B. Lympany, Chester A. Bielawski, Edward M. Grala, and Wallace W. Beaver (Brush Beryllium Co., Cleveland). Feb. 1962. Contract AF33(616)-7108. 244p.

Intermetallic compounds of $NbBe_{12}$, Nb_2Be_{17}, Nb_2Be_{19}, and Ta_2Be_{17} were fabricated by uniaxial pressing and sintering techniques. Results of sintering studies on Nb_2Be_{17} are presented and discussed. The effects of particle size, stoichiometry, temperature, and time upon the sintered density, grain size, and strength of Nb_2Be_{17} are described. A modulus of rupture evaluation is made on Nb_2Be_{17} up to 2750°F, and results of tensile, Young's modulus, thermal conductivity, and oxidation studies are discussed. The feasibility of scaling-up to large and complicated shapes by isostatic pressing, slip casting, extrusion, hot pressing, and flame spraying is demonstrated. The temperature-pressure-flow characteristics of several beryllides at temperatures of 2750 to 3050°F are evaluated together with microstructural stability. The metallurgical fabrication techniques of forging, forming, and rolling as applied to Nb_2Be_{17} are examined. (auth

25749 (BMI-1586) STUDY OF EXPERIMENTAL FUEL BODIES MADE FROM ALUMINA-COATED UO_2 PARTICLES. Stan J. Paprocki, Donald L. Keller, and William M. Pardue (Battelle Memorial Inst., Columbus, Ohio). July 16, 1962. Contract W-7405-eng-92. 22p.

The characterization of Al_2O_3-coated UO_2 particles and the fabrication of these materials into dense bodies containing approximately 60 volume % UO_2 was investigated. A finite percentage of particle coatings was defective and the material was upgraded prior to fabrication by a process of leaching and selective flotation. The fabrication technique producing optimum properties consisted of vibrationally compacting into metallic tubes mixtures of the particles with small additions of chromium, then isostatically hot pressing. In oxidation tests in 1200 and 1500°F air, densified cores declad by acid leaching failed relatively rapidly, although some improvement in resistance was provided by the presence of chromium. Defected clad fuel pins containing dense cores of coated particles showed greater resistance to oxidation at 1500 and 1750°F than did defected fuel pins with solid UO_2 cores. (auth)

25750 (BMI-X-196) FISSION-PRODUCT RELEASE FROM FUEL-ELEMENT CLADDINGS. Quarterly Progress Report for January–March 1962. Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 11p. (EURAEC-349)

The first in-pile release experiment was conducted in a beam hole of the Battelle Research Reactor. Work was begun on the solid-fission-product studies. Plates of Fe–Cr alloy were irradiated with one face of each plate in contact with a foil of natural uranium. Layers of various thicknesses were removed from the specimen and analyzed for fission products. (M.C.G.)

25751 (DMIC-Memo-155) THE EFFECTS OF SOLUTES ON THE DUCTILE-TO-BRITTLE TRANSITION IN REFRACTORY METALS. G. T. Hahn, A. Gilbert, and R. I. Jaffee (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). June 28, 1962. Contract AF 18(600)-1375. 60p.

A summary is given of the effects of both interstitial and substitutional solutes, as well as dispersions, on ductile-to-brittle transition in refractory metals. An attempt is made to provide a unified treatment of the effects of solutes in Groups V-A (V, Nb, and Ta) and VI-A (Cr, Mo, and W) transition refractory metals. Generalizations are presented in the form of propositions and are discussed and documented in some cases. It is concluded that there are two ways in which interstitials promote brittle behavior in the metals: by locating at the grain boundaries in the form of segregates or precipitates, promoting grain-boundary rupture and crack initiation; and in solid solution by inhibiting dislocation movement and reducing the resistance to crack propagation. Both embrittling effects operate in

Group VI-A metals; whereas, only the latter is significant in Group V-A at the levels of purity currently achieved. Methods for reducing low-temperature brittleness in the two groups are discussed. (P.C.H.)

25752 (GA-3211) STEADY-STATE RELEASE FRACTION OF KRYPTON AND XENON FISSION PRODUCTS AT HIGH TEMPERATURES FROM $(U,Th)C_2$–GRAPHITE FUEL MATRIX IN OUT-OF-PILE EXPERIMENTS. E. E. Anderson, P. E. Gethard, and L. R. Zumwalt (General Atomic Div. General Dynamics Corp., San Diego, Calif.). June 15, 1962. Contract AT(04-3)-314. 22p.

Presented at American Nuclear Society Meeting, Boston, June 18-21, 1962.

The release of krypton and xenon was measured as a function of temperature and half life in out-of-pile experiments under steady-state conditions. Nuclear fuels consisting of $(U,Th)C_2$ in a graphite matrix were heated in a furnace to temperatures ranging from 900 to 2000°C. Using the 32-Mev electron linear accelerator at General Atomic, the heated fuels were exposed to an intense x-ray field and underwent photofissioning. The release rate for xenon was found to be somewhat lower than that for krypton. For temperatures greater than 1100°C, log F (release fraction) was proportional to 1/T (°K). Apparent activation energies for krypton and xenon release were 29 and 39 kcal/mole, respectively. Below 1100°C there was a release that was relatively independent of temperature and this is attributed to a recoil process. (auth)

25753 (GAMD-2089) AN APPARATUS FOR MEASURING THE THERMAL CONDUCTIVITY OF GRAPHITE AT TEMPERATURES ABOVE 2000°F. J. H. VanSant (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 20, 1961. Contract AT(04-3)-314. 22p.

An apparatus, which was designed and constructed for the purpose of measuring thermal conductivities of graphites, is described. Outstanding features of the apparatus include the ability to make high temperature measurements, reliability of results, simplicity of operation, and ability to test large representative-sized graphite specimens. Also, by use of additional equipment, the apparatus can be used to measure thermal conductivity at temperatures greater than 4500 and less than 1500°F. Thermal conductivity values of several different graphites were measured at temperatures ranging from approximately 2000 to 3800°F. Results of the tests show the thermal conductivity of a carbon impregnated graphite (Sample A) to be equal to $10.04 - 0.000616T$, where T is degrees fahrenheit and $2500 < T < 3800$. Measuring accuracy was determined by an error analysis and a heat transfer accounting in the apparatus. Geometry of the test materials was limited to short tubes having an outer diameter ranging from 2 to $3\frac{1}{2}$ in. and having a wall thickness of not less than $\frac{1}{4}$ in. Heat travel through the test specimens was radial with an external heat source in the center and a heat sink around the outer periphery of them. Absolute steady state measurements were taken with heat-flux rates limited to less than 70,000 Btu's per hour per foot of length. (auth)

25754 (IS-437) THE ELECTRICAL RESISTIVITY OF MOLTEN AND SOLID THORIUM–MAGNESIUM EUTECTIC. Douglas M. Provow and Ray W. Fisher (Ames Lab., Ames, Iowa). May 1962. Contract W-7405-eng-82. 16p.

Electrical resistivity properties of polycrystalline 39 wt % thorium–magnesium eutectic are reported for the solid from room temperature to its melting point at 589°C and as a liquid from its melting point to 900°C. The electrical resistivity of the eutectic at the melting point was 69.5 microhm-centimeters; it decreased to a value of 64.8 microhm-centimeters at 900°C. Tantalum tubing was used to contain the alloy in the molten state. (auth)

25755 (MAB-180-M(Vol.II)) DEPARTMENT OF DEFENSE PROGRAM ON MATERIALS RESEARCH AND DEVELOPMENT. VOLUME II. REPORTS OF TECHNICAL REVIEW COMMITTEES, 1960–1961. (National Research Council. Materials Advisory Board). Dec. 31, 1961. 320p.

A compilation of reports is presented concerning the activities of technical review committees. Included are summaries of committee activities in the areas of materials requirements criteria for advanced design, metallic materials, organic materials, inorganic nonmetallic materials, fundamental aspects of materials research, fabrication and processing, and evaluation of materials. (J.R.D.)

25756 (NAA-SR-6264) THEORETICAL KINETICS AND STRESSES FOR DELTA-PHASE ISOTHERMAL HYDRIDING OF URANIUM–ZIRCONIUM. M. E. Nathan (Atomics International. Div. of North Americal Aviation Inc., Canoga Park, Calif.). July 15, 1962. Contract AT (11-1)-GEN-8. 49p.

A solution of the diffusion equation is presented for isothermal single-phase hydriding of infinitely long 3.50 cm diameter cylinders of 10 wt % U–90 wt % Zr alloy. Calculations are made to determine the theoretical kinetics of delta-phase hydriding of such alloy cylinders. Results are correlated to indicate the effects of temperature, time, and the radial hydrogen concentration gradient in existence at the start of the hydriding period. It is shown that these variables are best correlated by the use of the dimensionless ratio, $\Delta H_t/\Delta H_{t'}$, defined as the quantity of hydrogen absorbed at temperature t, relative to that which is absorbed at some reference temperature, t', for the same total time of hydriding. The kinetics correlation is shown to be dependent upon time of hydriding and type of radial hydrogen concentration gradient present at time zero, and independent of the absolute magnitude of the initial gradient. The stress equations of Timoshenko, derived for the heating of a long solid cylinder, are modified for the calculation of stresses during delta-phase isothermal hydriding. Calculated radial, tangential, and axial stresses, as a function of time, are presented for several of the extreme conditions considered in the study of hydriding kinetics. (auth)

25757 (NMI-9815) SOLUBILITY AND DIFFUSION OF GASES IN BERYLLIUM. Final Report. J. P. Pemsler, R. W. Anderson, and E. J. Rapperport (Nuclear Metals, Inc., Concord, Mass.). Mar. 14, 1962. Contract AF33(616)-7665. 32p.

Results of an experimental program to determine the solubility and diffusion rate of nitrogen, hydrogen, and oxygen in beryllium are reported. The solubility of nitrogen in beryllium at 1000°C is estimated to be about 60 ppm; this value appears to be temperature independent. The results of nitrogen diffusion experiments are considered tentative. The solubility of hydrogen in beryllium is believed to be very small. Measurement of the growth characteristics of hydrogen bubbles formed in beryllium by proton bombardment indicate a value for the diffusion coefficient of hydrogen in beryllium of 9×10^{-10} cm^2/sec at 850°C. Due to limitations of chemical analysis, no new data concerning the beryllium–oxygen system were obtained. (auth)

25758 (NP-11675) OPTICAL PROPERTIES OF SATELLITE SURFACE MATERIALS. THE THEORY OF OPTICAL AND INFRARED PROPERTIES OF METALS. Final Technical Summary Report, Part 3. E. E. H. Shin (Little

(Arthur D.) Inc., Cambridge, Mass.). Sept. 1961. Contract DA-19-020-ORD-4857. 248p. (C-62081)

A comprehensive theory based on a perturbation treatment of bulk electron-phonon processes is presented. The central feature of the theory is the derivation of the quantum correction factor which, when multiplied by the d.c. damping coefficient, gives the frequency-dependent damping coefficient. The theory is then combined with the already existing theories of Umklapp and impurity scattering processes. The theory successfully accounts for the optical properties of metals in the entire free electron region at all temperatures of practical interest. Detailed calculations are presented for monovalent metals and some polyvalent metals for which assumption of a symmetric Fermi surface is valid. Polyvalent and transition metals for which interband transitions are important and the Fermi surface is not spherical are also considered. In all more than a dozen metals for which reliable experimental data are available have been successfully treated. Calculations of the absorption properties of superconducting metals are also presented in an attempt to determine the extent to which bulk electron-phonon processes are responsible for infrared absorption by superconductors. (auth)

25759 (NP-11890) THE FRACTURE OF METALS UNDER IMPULSIVE LOADING CONDITIONS. John L. O'Brien (Harvard Univ., Cambridge, Mass.). Dec. 20, 1961. Contracts DA19-129-QM-1166 and Nonr-1866(35). 120p.

A modification of the Hopkinson pressure-bar technique was used to study the spalling of metals impacted with a compression shock-wave. The spatial distribution of pressure behind the wave front was determined by the measurement of the velocities of pellets inserted in the block. From this pressure distribution and the measured fracture distance, the tension stress at fracture was determined for fcc aluminum, copper, silver, nickel, and lead. The fracture stresses of two high-strength alloys of aluminum and copper were also determined. The modifications of the Hopkinson experiment involved the use of a front pellet, ahead of the fracture pellet, to remove the unknown front of the wave, as well as a variation in the depth of this pellet to vary the time of application of the fracture stress. The fracture began by the growth of cracks, and final failure occurred by the shear of metal separating crack tips. The normal stresses at fracture are much larger than the static fracture stresses and are a consequence of the large triaxial component of stress behind the wave front. The fracture stresses of the pure metals are compared to calculated theoretical strengths and found to be about one-tenth of the theoretical strengths. This suggests that fracture begins at the same type of defect in all the metals. Two possible defects to initiate fracture are vacancies and edge dislocations. Although the fracture stresses caused by these defects are not known, it is shown that the possible defect involves edge dislocations. Implications of the technique used to measure the fracture stress will be discussed. It is shown that the effect of compression stress preceding fracture on the fracture stress is caused by attenuation. The two-wave structure which is found in shocked metals, due to the support of finite shear stresses, is discussed. Because of this two-wave structure, this technique is not as good for the study of high-strength alloys as it is for the study of pure metals. The high-strength alloy dynamic fracture stresses are not as appreciably different from those of the pure metals as they are in static tests. (auth)

25760 (ORNL-3281) REVIEW OF ZIRCALOY-2 AND ZIRCALOY-4 PROPERTIES RELEVANT TO N.S. SAVANNAH REACTOR DESIGN. C. L. Whitmarsh (Oak Ridge National Lab., Tenn.). July 23, 1962. Contract W-7405-eng-26. 67p.

Information on zircaloy technology, with specific emphasis on environmental conditions similar to those present in the reactor core of the N. S. Savannah is discussed. Data on mechanical and corrosion properties, radiation effects, and other pertinent subjects are given. Out-of-pile data relevant to Zircaloy-2 structural components in the N. S. Savannah core show a yield strength of ~20,000 psi for annealed material, a creep rate of $<10^{-6}$%/hr at 15,000 psi, and corrosion of only a few mils in 20 years. The principal effects of radiation exposure are increased mechanical strength and decreased uniform elongation. Brittle fracture does not occur, however, because reductions in area permit local plastic deformation. The corrosion rate is increased by radiation exposure (less than a factor of 5), but even at the increased rate metal loss is insignificant. Except for hydrogen pickup, Zircaloy-4 exhibits essentially the same properties as Zircaloy-2. Excessive hydrogen content, with resulting precipitation of ZrH_2, causes embrittlement of Zircaloy-2. The pickup of hydrogen by Zircaloy-2 is about three times that of Zircaloy-4. On the basis of the available information, Zircaloy-4 appears to be adequate for use as the material of construction for the fuel element containers in the advanced core for the N. S. Savannah. Zircaloy-4 is recommended over Zircaloy-2 because of its lower hydrogen pickup. Recommendations for 20-year service life cannot be made with complete confidence, however, because of the necessary extrapolations of data. Hairline cracks in Zircaloy-2 sometimes occur during fabrication of the metal that are not always detected by present inspection methods. (auth)

25761 (PWA-2088) DETERMINATION OF THE EMISSIVITY OF MATERIALS. Progress Report, January 1–June 30, 1962. W. H. Askwyth (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Contract NASw-104. 22p.

An aluminum phosphate-bonded mixture of nickel-chrome spinel and silicon dioxide completed 7200 hours of endurance on a SNAP-8 finned-tube radiator segment. Plasma flame-sprayed coatings of titania on SNAP-8 and Sunflower I sections completed 5900 hours. A fourth rig containing a SNAP-8 section with an aluminum phosphate-bonded mixture of silicon carbide and silicon dioxide accumulated 4630 hours. Changes in the spectral emittance rig to simplify testing, provide greater accuracy, and extend the range of operating conditions are described. The design and construction of a new total emittance rig are described. The results of an endurance test of a calcium titanate coating on a niobium tube are given. (auth)

25762 (SCNC-264) AN EVALUATION OF UO_2–STAINLESS STEEL CORE MATERIALS. Herbert S. Kalish and Edmund N. Mazza (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Apr. 18, 1958. Contract AT(30-1)-Gen-366. 26p.

A study was made of the mechanical properties of UO_2–stainless steel core material as a function of fabrication variables and density. It was determined that the best mechanical properties and high density can be obtained by utilizing −140 +325 mesh granulated UO_2 in a −325 mesh type 316 stainless steel matrix. A thorough study was made of the actual density of various types of stainless steel powders through calculated density measurements and measurements by pycnometer. The addition of 3 wt % CaF_2 to Geneva-type uranium oxide was investigated. The CaF_2 addition resulted in a very significant increase in core material density, so that it was equivalent to core material

made with granulated oxide. Although the CaF_2 addition did not materially affect the mechanical properties at room temperature, the yield strength and ultimate tensile strength at 1600°F was significantly increased. The CaF_2 addition also improved the stress-rupture properties. The stress-rupture properties of core material containing the 302B stainless steel matrix were about the same as that having a 316 stainless steel matrix. Low density core material had the effect of lowering stress-rupture properties. The superiority in stress-rupture strength of −325 mesh UO_2 core material over the coarser sized −140 +325 mesh material was also observed. (auth)

25763 (TID-16191) DETERMINATION OF THE DILATION PARAMETERS IN MARTENSITIC TRANSFORMATIONS. H. M. Otte (RIAS, Div. of Martin Co., Baltimore). [Jan. 1962]. 10p.

For the face centered cubic (fcc:a_0) to the body centered tetragonal (bct:a,c) martensitic (or diffusionless phase) transformations, such as may occur in certain alloys of iron, for example, it is shown that if the correct variants of the habit, or interface plane and orientation relationship are known completely, then the elements of the lattice invariant (slip or twinning) shear can be calculated without knowing the lattice parameters involved or even their ratios, a/a_0, c/a_0. If in addition the ratios are known, then a maximum of two dilatation parameters can be determined. This dilatation strain is assumed to have the same principal axes as the Bain distortion, and may be considered as being imposed on the tetragonal martensite lattice at the interface. (auth)

25764 (TID-16222) PRESENT KNOWLEDGE ABOUT POINT DEFECTS IN DEFORMED FACE-CENTERED CUBIC METALS. Technical Report No. 26. R. W. Balluffi, J. S. Koehler, and R. O. Simmons (Illinois. Univ., Urbana). Feb. 1962. Contract AT(11-1)-182. 114p.

A survey was made to review present knowledge concerning the nature of the point defects present in a deformed metal, the mechanisms by which these defects are produced, and the ways in which they anneal out. Before the discussion of plastic deformation, however, a review is given of available information that relates to the more important physical properties of point defects. This information was obtained from theoretical calculations and from experiments which are thought to be simpler than plastic deformation experiments, that is, from: measurements of equilibrium defect concentrations at elevated temperatures; quenching-in and subsequent annealing of non-equilibrium defects; and low temperature radiation damage and annealing. With the aid of this information, a critical review of plastic deformation experiments is given and a discussion of the role of point defects is attempted. (auth)

25765 (WAPD-253) A METALLOGRAPHIC AND X-RAY STUDY OF THE UO_2– ZrO_2 SYSTEM. I. Cohen and B. E. Schaner (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1962. Contract AT(11-1)-GEN-14. 75p. (WAPD-T-1418)

The UO_2– ZrO_2 phase system was studied in the high temperature range of 1200 to 2350°C by x-ray and metallographic techniques. The results indicate a continuous face-centered-cubic solid solution from pure UO_2 to pure ZrO_2 in the temperature range of 2300 to 2550°C, thus confirming the existence of a third (cubic) polymorphic form of pure ZrO_2 in addition to the tetragonal and monoclinic phases stable at successively lower temperatures. A high-temperature two-phase region, previously unreported, was found to exist above 1660°C in the ZrO_2-rich portion of the phase diagram. The confusion concerning single-phase compositions quenched from high temperature and resulting in cubic or tetragonal structures without an intervening two-phase region was clarified by the discovery of a diffusionless transformation which occurs on cooling compositions of 55 mole % UO_2 or less, and its approximate location was established. A phase diagram of the UO_2– ZrO_2 system was constructed. (auth)

25766 (AEC-tr-5076) STUDY ON THE THERMAL CYCLING EFFECT OF URANIUM BY X-RAY INVERSE POLE FIGURE METHOD. I. STUDY ON URANIUM FUEL ELEMENT (7). Michio Ichikawa and Kiyoaki Taketani. Translated from Nippon Genshiryoku Gakkaishi, 2: 406-11 (1960). 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 23327.

25767 (AEC-tr-5211) COMPARATIVE INVESTIGATION ON THE GRAPHITE GRADES ALSW/AMT OF SIGRI AND KR66 OF KROPFMUHL-RINGSDORFF. (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Translated for Oak Ridge National Lab. Dec. 27, 1961. 31p.

A summary of the properties of two types of graphite, ALSW/AMT and KR66, which are of importance for use as fuel spheres in the AVR reactor, are given. Investigations showed that both types of graphite are probably applicable. However, ALSW/AMT in many respects is more favorable for use in the AVR reactor than KR66, while the reverse is true in other respects. In both types of graphite, the strengths increase after compacting, with KR66 having the higher strength values. (P.C.H.)

25768 (NASA-TT-F-102) HARD COMPOUNDS OF REFRACTORY METALS. G. V. Samsonov and Ya. S. Umanskii (Umanskiy). Translation of "Tverdyye Soyedineniya Tugoplavkikh Metallov" (a publication of the State Scientific-Technical Literature Publishing House, Moscow, 1957). 352p.

A review is given on properties, methods of production, and areas of use of the hydrides, carbides, nitrides, borides, and silicides of the refractory transition metals of groups IV, V, VI, VII, and VIII, as well as their alloys, which have great significance both in the metallurgy of special alloys and in the technology of producing hard alloys. 619 references are included. (auth)

25769 (SCL-T-434) A DEFORMATION (STRAIN) APPARATUS FOR THE MEASUREMENT OF THE ELECTRICAL RESISTANCE OF METALS AT LOWEST TEMPERATURES, AND INVESTIGATIONS INTO THE PLASTIC BEHAVIOR OF COPPER MONOCRYSTALS. Wolfgang Schuele, Otto Buck, and Eberhard Koester. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Z. Metallk.; 53: 172-7(1962). 18p.

A tensile machine, which enables the work-hardening properties of metal single crystals to be studied at any temperature between 4.2 and 300°K, is described. The change of electrical resistivity can be measured simultaneously during deformation and after temperature changes. Experiments on point defects and dislocations produced during deformation are discussed, and the results of detailed work-hardening experiments at very low temperatures are given. The critical shear-stress of copper single crystals increased with increasing content of impurities, increasing diameter, and decreasing temperature. The temperature trend of flat curve sections agrees well with the yield stress theory previously derived. (P.C.H.)

25770 (UCRL-Trans-826(L)) ON BERYLLIUM OXIDE AS A MINERAL AND ITS CRYSTAL STRUCTURE. G. Ami-

neff. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Z. Krist., 62: 113-22(1925). 24p.

The occurrence of BeO crystals in the mineral swedenborgite [$NaSb(AlO_3)_2$] is reported. The crystal form, optical properties, and crystal structure are described. (M.C.G.)

25771 THE CRYSTAL STRUCTURES OF TWO THORIUM GERMANIDE PHASES WITH COMPOSITIONS APPROXIMATING TO $Th_{0.5}Ge_2$ AND $ThGe_2$. Allan Brown (Univ. of Uppsala). Acta Cryst., 15: 652-6(July 10, 1962).

The structures of two germanium-rich thorium germanides were found to have C-face-centered orthorhombic symmetry. One of the phases represents a new structure type; the second has the $C49(ZrSi_2)$-type structure, is isostructural with UGe_2, and is probably stoichiometric $ThGe_2$. The first structure can be derived from the second by a simple crystallographic translation of some of the component atoms. The structures are discussed in the light of their close relationship with the anti-$C38(Fe_2As)$-type phases $ThAs_2$, $ThSb_2$, and $ThBi_2$ and their similarity to the polymorphs of $ThSi_2$. The first phase is thought to have a defect structure and a composition close to $Th_{0.5}Ge_2$. (auth)

25772 ATOMIC ARRANGEMENTS IN TITANIUM–MOLYBDENUM SOLID SOLUTIONS. J. M. Dupouy and B. L. Averbach (Massachusetts Inst. of Tech., Cambridge). Acta Met., 9: 755-63(Aug. 1961). (NYO-7062)

The short range order and size effect coefficients as well as the thermal and static atomic displacements were measured in bcc solid solutions of titanium-molybdenum using x-ray diffraction techniques. These solutions exhibit a strong preference for unlike near-neighbors even though a superlattice was not found. The size effect coefficients for the first shell of atoms were negative, indicating that the molybdenum atoms were smaller than the titanium atoms in solution. Center-to-center distances between the different pairs of nearest neighbor atoms were calculated from the size effect coefficients and the lattice parameters. Ti-Ti and Mo-Mo distances tended to approach the average distance in the solution at compositions between 20 and 50 at.% molybdenum. At 75% molybdenum the Mo-Mo distance was smaller than in pure molybdenum and this was taken to indicate an electron exchange in the solution. (auth)

25773 THERMAL EXPANSION OF SYNTHETIC GRAPHITES BETWEEN 80° AND 2000°F. Robert D. Allen (Jet Propulsion Lab., Pasadena, Calif.). Am. Ceram. Soc. Bull., 41: 460-6(July 15, 1962).

The mean linear and cubical coefficients of thermal expansion of eight commercial lots of graphite were determined for temperature intervals between 80 and 2000°F. The linear thermal expansion was measured with an automatic recording dilatometer using a rod-shaped specimen 2 in. long and $\frac{1}{4}$ in. across. The specimen was heated in an atmosphere of helium. The results are in good agreement with those of Currie, Hamister, and MacPherson. The mean linear coefficient was found to increase with temperature. The mean linear coefficients from 80 to 2000°F were 1.50 to 2.34×10^{-6}/°F parallel and 2.26 to 3.45×10^{-6}/°F perpendicular to the grain and were found to vary linearly with the electrical resistivity measured at 32°F. (auth)

25774 CARBON—AN OLD BUT NEW MATERIAL. P. L. Walker, Jr. Am. Scientist, 50: 259-93(June 1962).

The ideal crystal structure of carbon (graphite) is described, and deviations from this structure are discussed. Electrical and thermal properties of carbon crystals are reviewed, and methods of preparing carbons yielding widely-diverse properties are explained. (L.N.N.)

25775 RESISTIVITY IN THE MASSIVE STATE OF ALUMINUM SAMPLES OF DIFFERENT PURITIES AND FREE ELECTRON PATHS AT TEMPERATURES OF LIQUID HELIUM AND HYDROGEN. Frédéric Montariol and Robert Reich. Compt. rend., 254: 3357-9(May 7, 1962). (In French)

It is shown that at the temperatures of liquid helium and hydrogen the sample dimensions have a great effect on resistivity. The resistivity in the massive state and the free path of electrons at 4.2 and 20.4°K for specimens with different purities were calculated with formulas established by MacDonald and by Nordheim. (tr-auth)

25776 CONTRIBUTION TO THE STUDY OF THE FRAGILITY OF THE IRON–ALUMINUM SOLID SOLUTION. Gérard Cabane, Pierre Mouturat, Pierrette Pépin, Jean Petit, Gérard Sainfort, and Marc Salesse. Compt. rend., 254: 3360-2(May 7, 1962). (In French)

Alloys of iron and aluminum form, in the range between 25 and 50 at.%, an extremely fragile ordered FeAl solid solution. It was shown that this fragility is principally of an intergranular character. By the use of appropriate preparation conditions (pure metals, fine grains, weak thermal stresses), it is possible to obtain products transformed with heat with much improved mechanical characteristics. (tr-auth)

25777 ELECTRICAL RESISTANCE OF ALUMINIUM AT LOW TEMPERATURES. A. Maimoni (Univ. of California, Livermore). Cryogenics, 2: 217-22(June 1962). (UCRL-6480)

Data on the low-temperature electrical conductivity of commercially available high-purity aluminum are presented. Accuracy sufficient to allow proper design of cryogenic magnets was obtained. Effects of different annealing treatments on the residual resistance and on the values of reduced intrinsic resistance as a function of temperature were examined. No information on magnetoresistance was obtained. (L.N.N.)

25778 THE VAPOR PRESSURE OF SCANDIUM METAL. V. V. Karelin, An. N. Nesmeyanov, and Yu. A. Priselkov (Moscow Univ.). Doklady Akad. Nauk S.S.S.R., 144: 352-4 (May 11, 1962). (In Russian)

The vapor pressure of scandium metal was determined at 1323 to 1517°K by measuring the rate of evaporation through a fixed opening in a Knudsen type of instrument. The amount of scandium evaporated was determined radiometrically by using Sc^{46} as a tracer. A least squares fit of the data gave the following equation for the vapor pressure of saturated scandium vapor: lg P (mm Hg std) = 8.6553 – (17,576/T). The heat of sublimation of scandium at 298°K was calculated to be 82.28 kcal/g-atom. These values are somewhat higher than those of Spedding. (TTT)

25779 AN EXPERIMENTAL STUDY OF THE ENTHALPY OF TUNGSTEN IN THE TEMPERATURE RANGE OF 2400 TO 2820°C. V. A. Kirillin, A. E. Sheindlin, V. Ya. Chekhovskoi, and V. A. Petrov (Moscow Power Engineering Inst.). Doklady Akad. Nauk S.S.S.R., 144: 390-1(May 11, 1962). (In Russian)

A displacement method was used to determine the heat capacity and enthalpy of a polished 110 gram sample of tungsten metal. The temperature was measured with a calibrated pyrometer with an error of < 0.5%. The measurements were made in argon at a pressure of 1.05 atm., and were checked by running control experiments in vacuum at a temperature > 2000°C. The maximum experimental

error is estimated as 1.2%. The following empirical equation, which was proposed for temperatures of 0 to 2400°C, can also be used for temperatures up to 2820°C: $i_t - i_{0°C} = 0.03170t + 2.75 \times 10^{-6}t^2 + 8.1 \times 10^{-11}t^3$ kcal/kg. (TTT)

25780 THE EFFECT OF THE PARTICLE SIZE OF SINTERED BERYLLIUM POWDER ON ITS APPARENT DENSITY AND ELECTRICAL RESISTIVITY. Hiroshi Nakatani (Denki Shikensho Iho, 26: 278-84(Apr. 1962). (In Japanese)

The effect of the particle size on the apparent density and electrical resistivity in sintered beryllium was studied. The temperature coefficient of the electrical resistivity of sintered, rolled and annealed beryllium plate was determined. The higher apparent density of compact was obtained for powder containing coarser particles before sintering than for powder containing finer particles after sintering. The value of the temperature coefficient of electrical resistivity from 0 to 100°C is 6.3×10^{-3}. (auth)

25781 CONCRETE USAGE IN ATOMIC POWER REACTOR SUPPORT. Artemy A. Wachrameeff and Robert D. Chellis. J. Am. Concrete Inst. Proc., 59: 1081-93(Aug. 1962).

Use of a concrete structure at an atomic power plant as a support for the reactor, as a biological radiation shield, and as a missile shield is described. Reasons are given for selecting conventional-aggregate concrete, instead of "heavy" concrete, around and under the reactor to retain radioactive emissions passing through the tank walls and surrounding water. A spherical shell selected to form the vapor container is carried on a ring of support columns resting on individual footings. The columns of the reactor support pierce this sphere surrounded by gas-tight bellows seals. This construction isolates the sphere from the effects of differential expansions and settlements of the reactor structure and permits use of a relatively thin, unlined steel shell. The design basis for the concrete support is given, including effects of creep and differential settlements. Also considered are possible serious consequences of applying standard allowable unit shear values to concrete members which may be in net tension over the entire cross section because of differential settlements. (auth)

25782 LIQUID METALS. PART V. THE ROLE OF OXIDE FILMS IN THE WETTING OF IRON, COBALT, AND NICKEL BY LIQUID SODIUM, AND BY SOLUTIONS OF BARIUM AND CALCIUM IN LIQUID SODIUM. C. C. Addison, E. Iberson, and J. A. Manning (University, Nottingham). J. Chem. Soc. 2699-705(July 1962).

Receding contact angles for liquid sodium on iron, cobalt, and nickel surfaces in a pure argon atmosphere were studied as a function of time and temperature. All observations can be correlated on the basis that the changes in contact angle reflect the reduction, by sodium, of the invisible oxide film present on the transition-metal surfaces after abrasion to a mirror surface in air. Nickel carries only one oxide, irrespective of temperature, and wetting rates vary uniformly with temperature. The oxide films on iron and cobalt change at about 225° and 250 to 300°, respectively, and wetting rates also change abruptly at these temperatures. Each metal possesses a critical wetting temperature (Fe 140°, Co 190°, Ni 195°) below which no wetting occurs, and below which it is believed that no reduction of the oxide film is possible. Addition of small quantities of calcium (>0.07%) or barium to liquid sodium influences wetting rates profoundly. (auth)

25783 THE LATTICE PARAMETER AND DENSITY OF BERYLLIUM OXIDE DETERMINED BY PRECISE X-RAY METHODS. B. Bellamy, T. W. Baker, and D. T. Livey (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 6: 1-4(May-June 1962). (AERE-R-3774). (In English)

Six samples of BeO were prepared by calcination in air of hydroxide, sulfate, and oxalate to give powders of varied purity. The lattice parameters were calculated from x-ray patterns obtained with a precision camera and found to be equal within the errors of measurement. The parameters of one sample were determined more accurately using a least squares method and a computer to give the following values at 21°C: $a = 2.6979 \pm 0.0001$ and $c = 4.3772 \pm 0.0002$ A. The corresponding density was 3.0100 ± 0.0003 g/cm^3. (auth)

25784 BEHAVIOUR OF INCLUSIONS IN BERYLLIUM UNDER COMPRESSION AT ROOM TEMPERATURE. S. Koda and S. Morozumi (Tohoku Univ., Sendai). J. Nuclear Materials, 6: 5-12(May-June 1962). (In English)

The behavior of inclusions in the vacuum-melted beryllium specimens which were made from pebble and flake metals with or without addition of Al, Si, BeO, or air was investigated. Inclusions of all kinds of shapes except some small ones interacted with slip and twin deformation. The following phenomena were observed: coherent deformation of the aluminum-rich phase, separation of inclusions from the matrix, cleavage of inclusions, initiation of new slip and twinning in the matrix at the boundary between the inclusion and the matrix, and occurrence of crack from the boundary into the matrix. When a crack approached inclusions including a cluster of oxide, the crack was developed, with further deformation accompanying the separation of the inclusions from the matrix and/or the cleavage of the inclusions. (auth)

25785 PHASE EQUILIBRIA IN URANIUM-RICH BINARY ALLOYS CONTAINING MOLYBDENUM AND ZIRCONIUM AND THE EFFECT OF TERNARY ADDITIONS OF CARBON. R. L. Craik (C. A. Parsons and Co. Ltd., Newcastle-upon-Tyne, Eng.), D. Birch, C. Fizzotti, and F. Saraceno. J. Nuclear Materials, 6: 13-25(May-June 1962). (In English)

The metallographic characteristics of the microstructures obtained when uranium rich alloys are slowly cooled to room temperature, with intervening step-annealing treatments at and below 950°C, are described. These alloys contain binary additions of molybdenum and zirconium and ternary additions of carbon with molybdenum or zirconium. The optical and particularly the replica electron microscope techniques adopted for the metallurgical examination of these alloys enabled distinction to be made between the constituent phases which are present in these alloys. The possible effects of the microstructural condition of these alloys during irradiation are discussed. (auth)

25786 STUDIES ON URANIUM–PLUTONIUM–MOLYBDENUM ALLOYS. René Boucher (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). J. Nuclear Materials, 6: 84-95(May-June 1962). (In French)

In connection with the manufacture of fuel elements for fast reactors, studies were made of the thermal behavior of ternary U–Pu–Mo alloys containing 20% Pu and 8, 10, or 12% Mo, and also of one containing 60% U, 30% Pu, and 10% Mo. Since there is a phase transformation near 525°C, dimensional changes of alloy samples were measured during the breakdown of the high temperature phases at 350, 400, 450, and 500°C. It was found that as-cast alloys behaved similarly to alloys which were quenched. In all cases the transformations took place slowly and dilatometric changes were small. (auth)

25787 STUDY OF THE POROUS STRUCTURE OF NUCLEAR GRAPHITES WITH A MERCURY POROSIMETER. M. Bocquet (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 6: 96-106(May-June 1962). (In French)

A mercury porosimeter was developed with a view to its application to the study of nuclear-grade graphites. The operation of the instrument depends on the phenomenon of capillary depression. The relationship between the radius r of a pore and the pressure p at which the mercury can penetrate into it is established; $pr = -2\sigma \cos\theta$, where σ is the surface tension and θ the contact angle of mercury. Following some theoretical considerations, the apparatus is described. It permits the mercury pressure to be gradually varied between 6 cm of mercury and 1000 kg/cm^2, and by these means to establish the pore radius distribution in the range 92 μ to 75 A. The results of a study of nuclear graphites revealed the influence of the nature of the coke from which the product is prepared on the pore structure of the latter. The effects resulting from up to five successive pitch impregnations were examined. The first three impregnations improved the quality of the graphite in respect of porosity and apparent density. The fourth impregnation slightly increased the apparent density. The fifth impregnation had no further effect. (auth)

25788 LATTICE STRAINS IN β-QUENCHED URANIUM. M. K. Asundi, V. S. Arunachalam, and K. Tangri (Atomic Energy Establishment, Trombay, India). J. Nuclear Materials, 6: 123-6(May-June 1962). (In English)

Studies were made of lattice strain due to β-quenching of uranium in an attempt to determine whether saturation characteristics exist in multiple β-quenched specimens. Uranium samples were heated to 700°C and held at that temperature for 15 min. They were then quenched by allowing a jet of ice cold water to impinge on the sample. This cycle was repeated for multiquenched specimens. The variation of Fourier coefficients A_L with averaging distance L for various quenches is shown. The lattice strains measured in single quench experiments from (112) and (131) reflections compared very favorably with the lattice strains produced during 10% reduction by cold rolling of uranium. However, in the case of the triple quench, the lattice strain was higher than that observed in 60% cold rolled uranium. In the pentaquenched specimen the strain from the (131) reflection reached a value comparable to that for the single quenched, while the strain from the (112) reflection disappeared. (M.C.G.)

25789 TEXTURE IN HOT-EXTRUDED BeO. J. G. Hunt and R. B. Russell (Nuclear Metals, Inc., Concord, Mass.). J. Nuclear Materials, 6: 142-3(May-June 1962). (In English)

In order to determine whether hot-extruded hexagonal close-packed (hcp) BeO as a $(10\bar{1}0)$ fiber texture similar to hcp metals like Be, Ti, and Zr, some 13 3-to 5-mm diameter hot-extruded BeO rods were examined in composite for texture by x-ray diffraction. It was found that, since the highest pole densities, corresponding to 9.5 to 13% lie within the area bounded by the poles $10\bar{1}0$, $10\bar{1}1$, $21\bar{2}2$, and $11\bar{2}0$, the texture could be considered a degenerate $(10\bar{1}0)$ fiber texture involving about 80% of the crystallites. (M.C.G.)

25790 METALLOGRAPHIC EXAMINATION OF INTERGRANULAR CREEP CAVITIES IN TWO MAGNESIUM ALLOYS. J. E. Harris, V. J. Haddrell, and G. A. Rickards (Berkeley Nuclear Labs., Berkeley, Gloucester, Eng.). J. Nuclear Materials, 6: 144-7(May-June 1962). (In English)

Two metallographic techniques for examination of intergranular creep cavities were investigated which do not rely on the use of reactive chemicals: direct optical observation of surfaces which were microtomed and of surfaces which were cathodically etched. Cavitated specimens of two Mg alloys were used. Microtoming and ion bombardment etching are described. (M.C.G.)

25791 INTERMEDIATE PHASES IN SUPERCONDUCTING NIOBIUM–TIN ALLOYS. L. L. Wyman, J. R. Cuthill, G. A. Moore, J. J. Park, and H. Yakowitz. J. Research Natl. Bur. Standards, 66A: 351-63(July-Aug. 1962).

In attempting to produce superconducting wire of the niobium sheath Nb_3Sn core type, metallographic examination showed that such materi are heterogeneous and contain a number of intermediate phases. Detailed metallographic studies were made on diffusion zones in which tin was allowed to react with porous niobium blocks, with fused niobium rod, and with niobium wires, and on a number of reacted powder mixtures. The phases produced were identified by anodizing to characteristic colors and by microspot analysis, supplemented by some hot-stage microscope and thermal analysis tests. A tentative revised diagram is offered to illustrate the types of reactions which occur in the system. The presumably desired phase, Nb_3Sn, is found to lie between the more easily formed phases Nb_4Sn and Nb_2Sn_3, which are stable to temperatures well above the peritectoid decomposition of the Nb_3Sn. At lower temperatures the compound Nb_2Sn is formed. It is indicated that the high-temperature treatment to react niobium and tin should be followed either by very slow cooling or by an anneal in the 600 to 700°C range to form Nb_3Sn. (auth)

25792 WHAT COLUMBIUM DOES TO CARBON STEEL. F. E. Van Voris (Union Carbide Corp., Cleveland). Metal Progr. 82, No. 2: 84-7(Aug. 1962).

When added in amounts up to 0.05%, niobium raised tensile and yield strengths, lowered ductilities, and refined grain sizes in carbon steels. Though transition temperatures were raised in hot rolled material, this effect was reversed by normalizing. Niobium alloyed plates up to $\frac{3}{8}$ in. are being applied commercially. (auth)

25793 COBALT-END OF THE TERNARY COBALT-ALUMINUM-BORON SYSTEM. H. H. Stadelmaier and R. A. Gregg (North Carolina State Coll., Raleigh). Metall., 16: 407-8(May 1962). (In German)

The phase diagram in the cobalt end was worked out by metallographic and x-ray studies of Co-Al-B alloys in the as-cast state and after 200 hrs of ignition at 800°C. The composition of the congruent melting ternary borides with a lattice parameter between 10.48 and 10.52 Å was found in a small range around $Co_{20}Al_3B_6$. (tr-auth)

25794 INVESTIGATIONS ON COPPER–ZIRCONIUM ALLOYS. I. DETERMINATION OF THE SOLUBILITY OF ZIRCONIUM IN HIGHLY PURE COPPER. U. Zwicker (Metall-Laboratorium der Metallgesellschaft AG, Frankfurt am Main). Metall, 16: 409-12(May 1962). (In German)

A new determination of the solubility limits of Zr in Cu was made on the purest possible zirconium and copper in alloys melted in an electric arc furnace. The preparation of the high-purity metals is first described. The experimental determination of the solubility at 900, 800, 600, and 400°C was done by metallographic studies and measurements of conductivity. The effect of zirconium on hardness was also investigated. (J.S.R.)

25795 SILICON NITRIDE AS A HIGH TEMPERATURE MATERIAL. D. M. Rae (Admiralty Materials Lab., Poole, Dorset, Eng.). NRDC (Natl. Research Develop. Corp.) Bull., No. 15, 4-10(Oct. 1959).

A new material having excellent thermal shock and oxidation resistance and adequate creep strength at 1200°C was produced as a result of a search for stator blade materials for use in gas turbines at 1200°C. The best material was found to be silicon nitride stiffened with a fine dispersion of silicon carbide. The methods of producing components in the best physical form for the projected application are described, together with a short account of its properties, and field trials in experimental gas turbines. (auth)

25796 SILVER-INDIUM-CADMIUM, A CONTROL ROD MATERIAL FOR PRESSURIZED WATER REACTORS. H. W. Graves, Jr., J. J. Lombardo, and J. S. Theilacker (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 13: 299-300(July 1962).

Ni plating of Ag-In-Cd control rod alloys to a thickness of 0.005 to 0.05 in. is found to yield a durable coating that does not undercut. The use of Ag-In-Cd control rods in the Yankee power reactor is reviewed, with attention to their endurance, their lifetime with respect to core lifetime, their worth as a function of irradiation dose, their surface absorption as a function of reactor energy density, and the dependence of reactivity on the total control rod surface area/reactor volume ratio. (T.F.H.)

25797 EFFECTS OF ALLOYING ADDITIONS ON THE $\gamma \rightleftharpoons \alpha$ TRANSFORMATION OF CERIUM. PART I. PURE CERIUM. K. A. Gschneidner, Jr., R. O. Elliott, and R. R. McDonald (Los Alamos Scientific Lab., N. Mex.). Phys. and Chem. Solids, 23: 555-66(June 1962). (In English)

A high-purity cerium specimen (99.53 a/o pure) was examined by dilatometric means in the temperature range 20-475°K and under pressures of 0-10,000 atm, and by x-ray techniques at room temperature following a variety of heat treatments. In these studies, the lattice constants of γ-Ce (fcc a = 5.1601 Å), β-Ce (hex., a = 3.673 Å, c = 11.802 Å), and a new phase designated as α-γ intermediate-Ce (also fcc, a = 5.1233 Å) were determined. From the dilatometric and x-ray data, the pseudo-equilibrium pressure-temperature diagram of cerium involving the α, β and γ allotropes was calculated. (auth)

25798 PSEUDO-BINARY SYSTEMS INVOLVING RARE EARTH LAVES PHASES. J. H. Wernick, S. E. Haszko, and D. Dorsi (Bell Telephone Labs., Murray Hill, N. J.). Phys. and Chem. Solids, 23: 567-72(June 1962). (In English)

The phase relations in a number of pseudo-binary systems involving rare earth Laves phases were determined. Complete series of cubic solid-solutions occur in the $DyMn_2$-$HoMn_2$, $HoMn_2$-$HoFe_2$, $DyMn_2$-$DyFe_2$, $HoMn_2$-$HoAl_2$, $TbMn_2$-$TbAl_2$, and $DyMn_2$-$DyAl_2$ pseudobinary systems. Deviations from linearity in the lattice constants with composition occur in all these systems. Complete series of cubic solid-solutions also exist in the $GdAl_2$-$ErAl_2$, $GdAl_2$-$PrAl_2$, $GdAl_2$-$NdAl_2$, $GdAl_2$-$DyAl_2$, $TbAl_2$-$NdAl_2$, and $TbAl_2$-$DyAl_2$ systems. For these systems, no deviation from linearity occurs in the lattice constants. For the $DyFe_2$-$DyAl_2$ and $DyCo_2$-$DyAl_2$ systems, two new ternary phases, DyFeAl and DyCoAl, form and have the $MgZn_2$ structure. Their structures were determined from x-ray powder data only. The electronic state giving rise to the formation of these ternary phases is discussed qualitatively. For the $DyMn_2$-$TmMn_2$ system, the range of composition in which the cubic $MgCu_2$ and hexagonal $MgZn_2$ structures exist are reported. No complete series of solid solutions or intermediate phases are formed in the $DyNi_2$-$DyAl_2$ system. (auth)

25799 SEEBECK EFFECT IN Mg_2Si SINGLE CRYSTALS. M. W. Heller and G. C. Danielson (Ames Lab., Ames, Iowa). Phys. and Chem. Solids, 23: 601-10(June 1962). (IS-362) (In English)

The Seebeck coefficients (thermoelectric powers), resistivities, and Hall coefficients of Mg_2Si single crystals were measured from 7 to 1000°K. At low temperatures, the magnitude of the Seebeck coefficient showed a pronounced maximum which is interpreted in terms of the phonon drag effect. Both n- and p-type crystals exhibited this effect. The magnitude of the phonon contribution to the Seebeck coefficient was found to be proportional to $T^{-3.0}$ at temperatures above the boundary scattering range. In the intrinsic temperature range (650 to 1000°K), the Seebeck coefficients of the n-type samples were proportional to 1/T and implied a ratio of electron to hole mobility of about 3.5. The density-of-states effective mass parameters were calculated both from data in the extrinsic (200 to 300°K) and intrinsic temperature range. Consistent results of $m_n = 0.5m_0$ and $m_p = 2m_0$ were obtained if it was assumed that optical mode scattering predominated in the pure n-type samples above 200°K, but that optical mode scattering and ionized impurity scattering were comparable in the doped p-type samples between 200 and 300°K. (auth)

25800 AN X-RAY AND NEUTRON DIFFRACTION ANALYSIS OF LITHIUM HYDRIDE. R. S. Calder (Cavendish Lab., Cambridge, Eng.), W. Cochran, D. Griffiths, and R. D. Lowde. Phys. and Chem. Solids, 23: 621-32(June 1962). (In English)

Twenty-one independent structure factors of LiH were measured with x-rays to an absolute accuracy of ~ ½%, and fifteen with neutrons to an absolute accuracy of ~ 2½%. The electron density in the hydrogen ion at room temperature was determined to within 0.004 electrons A^{-3}, and it is shown that the hydrogen ion is contracted in the crystalline environment to approximately the degree calculated by Waller and Lundqvist and by Hurst. The x-ray data suggest that the ionic charge is between 0.8 and 1 electron, while a discussion of the lattice dynamics shows that the infrared reflectivity and dielectric constants indicate an ionic charge in the same range. (auth)

25801 CRYSTAL STRUCTURE OF RARE EARTHS. Y. A. Rocher (Physique des Solides, Group II, Faculté des Sciences, Orsay, France). Phys. and Chem. Solids, 23: 759-65(June 1962). (In French)

In rare earths, the magnetic energy related to the indirect ff interaction between magnetic ions through the conduction electrons is shown to be responsible for the body-centered cubic structure of europium, provided this metal be divalent at low temperature, and for the hexagonal close-packed structure of gadolinium and following elements. It accounts for the anomalies in the expansion coefficient observed at low temperature in gadolinium, dysprosium, and erbium. (auth)

25802 DETERMINATION OF THE RATE OF HEAT GENERATION OF PLUTONIUM METAL. Thomas A. Sandenaw (Los Alamos Scientific Lab., N. Mex.). Phys. and Chem. Solids, 23: 825-6(June 1962). (In English)

A calorimetric method for determining heat-generation-rate in plutonium is described along with the calorimeter used. The rate was determined over the temperature range 0 to 35°C and was found to be 2.2125 mw/g. This value is in agreement with Treiman's value of 2.2157 mw/g. (N.W.R.)

25803 Nb_3In: A β-TUNGSTEN STRUCTURE SUPERCONDUCTING COMPOUND. M. D. Banus, T. B. Reed, H. C. Gatos, M. C. Lavine, and J. A. Kafalas (Massachusetts Inst. of Tech., Lexington). Phys. and Chem. Solids, 23: 971-3(July 1962). (In English)

High-pressure techniques were employed to synthesize a new compound, Nb_3In having the β-tungsten structure (A15) with a lattice parameter $a_0 = 5.303$ Å. Its superconducting transition temperature was found to be 9.2 ± 0.1°K. (auth)

25804 THE THERMODYNAMIC PROPERTIES OF SUPERCONDUCTING V_3Ga. B. B. Goodman (Institut Fourier, Grenoble, France). Phys. Letters, 1: 215-17 (June 15, 1962). (In English)

The reversible component of the magnetic behavior of V_3Ga, deduced from specific-heat measurements, resembles that predicted for superconductors of negative surface energy. (L.N.N.)

25805 THERMODYNAMIC CONSISTENCY OF CRITICAL FIELD AND SPECIFIC HEAT DATA FOR SUPERCONDUCTING Sn AND In. D. E. Mapother (Univ. of Illinois, Urbana). Phys. Rev., 126: 2021-9 (June 15, 1962).

The accuracy with which data satisfy the thermodynamic relations between the magnetic and calorimetric properties of a superconductor is considered. A procedure for calculating the entropy and specific heat differences from critical field data is described. The results are compared with corresponding quantities derived from calorimetric measurements. Agreement is good over most of the temperature range of the observations. Critical field measurements are capable of yielding the changes in the thermodynamic properties at the transition with an accuracy at least equal to that achieved in calorimetric work. (auth)

25806 LOW-TEMPERATURE SPECIFIC HEAT OF BODY-CENTERED CUBIC Ti–V ALLOYS. C. H. Cheng, K. P. Gupta, E. C. Van Reuth, and Paul A. Beck (Univ. of Illinois, Urbana). Phys. Rev., 126: 2030-3 (June 15, 1962).

The electronic specific heat coefficient, γ, of V and of bcc Ti–V alloys was measured. A maximum of γ occurs at approximately 60 at.% V. The electronic specific heat coefficients correlate well with the superconductive transition temperatures according to the Bardeen-Cooper-Schrieffer theory, with an interaction coefficient V independent of composition. From the exponential dependence of the electronic specific heat in the superconductive state on the reciprocal temperature, an energy gap of 0.0014 to 0.0025 ev was calculated, depending on the composition. (auth)

25807 DISLOCATION RELAXATION SPECTRA OF COLD-WORKED BODY-CENTERED CUBIC TRANSITION METALS. R. H. Chambers and J. Schultz (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev. Letters, 6: 273-5 (Mar. 15, 1961). (GA-1745)

Results are presented concerning the defect structure introduced into bcc transition metals by cold work. Peaks were found in the internal friction vs temperature curves of Nb, Ta, Mo, and W. Data are shown on specimens of these metals which were given a 3% tensile prestrain at 300°K (~ 600°K for W). Other data are included on fine-grained Mo prestrained 1%. (J.R.D.)

25808 THE WORK FUNCTION OF URANIUM. J. C. Rivière (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 80: 116-23 (July 1, 1962). (AERE-R-3819)

The average work functions of vacuum-deposited uranium films and of uranium foil were measured by the Kelvin contact-potential-difference method, under ultra-high vacuum conditions. The reference surface was that of well-aged polycrystalline tungsten. A reproducible value of 3.203 ± 0.013 ev was found for the work function of the vacuum-deposited films. In the case of the foil, the work function increased continuously and monotonically with the duration of electron bombardment, eventually reaching a limiting value of 3.080 ± 0.005 ev after about thirty-three hours' bombardment. Reasons were put forward for suggesting that the surface of the foil was not that of clean uranium, but of a patchwork of uranium and uranium monoxide. (auth)

25809 THE WORK FUNCTION OF THORIUM. J. C. Rivière (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 80: 124-9 (July 1, 1962). (AERE-R-3910)

The average work functions of vacuum-deposited thorium films and of thorium foil were measured by the Kelvin contact-potential-difference method, under ultra-high vacuum conditions. A reproducible value of 3.455 ± 0.012 ev was found for the work function of the vacuum-deposited films. In the case of the foil, the work function increased continuously with the duration of electron bombardment, eventually reaching a limiting value of 3.728 ± 0.010 ev after ninety-seven hours of bombardment. Reasons were discussed for identifying this value with the average work function of well-aged, polycrystalline thorium. (auth)

25810 ORIENTATIONS OF NEW PHASES PRODUCED IN NICKEL–BERYLLIUM AND COPPER–BERYLLIUM AGEING ALLOYS. Yu. A. Bagaryatskii and N. T. Travina (Inst. of Metal Science and Physics of Metals, USSR). Soviet Phys.-Cryst., 7, No. 1, 104-8 (July-Aug. 1962). (In English)

A study was made on the phases in Be–Ni alloys and they were compared with phases in Be–Cu alloys. The orientation was deduced from rotational patterns. Results indicated that the β-phase of the Be–Ni alloys is oriented almost as proposed for Cu–Be alloys: $(110) \parallel (111)_M$, $[001] \parallel [0\bar{1}1]_M$, the possible deviation being not more than 2 to 3°. (M.C.G.)

25811 EFFECTS OF COLUMBIUM ON THE PROPERTIES OF ALUMINUM-KILLED, MEDIUM-CARBON STEEL. E. E. Fletcher, A. R. Elsea, and E. C. Bain (Battelle Memorial Inst., Columbus, Ohio). Trans. Am. Soc. Metals, 54: 1-11 (Mar. 1961).

The effects of adding 0.012, 0.09, 0.17, and 0.35% Nb to a 0.35% carbon steel were investigated. The study of response to heat treatment included determining the effects of Nb on the grain-growth, carbide-solution, hardenability, and tempering characteristics of this heat-treatable steel. Niobium was found to provide a strong resistance to grain growth at elevated temperatures. Because NbC goes into solution very slowly, it was not practicable to take it all into solution for steel containing 0.09% and more Nb. For those austenitizing conditions that did not coarsen the grain, increasing the Nb content reduced hardenability. However the hardenability increased with increasing grain size. The addition of Nb raised the yield and tensile strengths by as much as 8,200 psi without loss in elongation or reduction in area. The greatest strength was obtained with a Nb content of only 0.012%. For all but one condition of heat treatment studied, Nb either lowered the notched-bar impact-transition temperature or had no appreciable effect on it. (auth)

25812 EFFECT OF SURFACE FINISH ON PROPERTIES OF BERYLLIUM SHEET. W. V. Ward, M. I. Jacobson, and C. O. Matthews (Wright Air Div., Wright-Patterson AFB, Ohio). Trans. Am. Soc. Metals, 54: 84-95 (Mar. 1961).

The effect of various surface finishes on the mechanical properties of beryllium sheet was investigated. As-received, surface-ground, milled, shot-peened, and etched surfaces were evaluated by tension tests (at room, subzero, and elevated temperatures), notched tensile tests, fatigue tests, and impact tests. Metallographic examination re-

vealed surface and subsurface defects in all specimens except those with etched surfaces. The beryllium specimens that were etched to remove surface defects caused by machining were found to have the best mechanical properties. Ductility was low in all cases, being limited by the presence of notches and by preferred orientation in the sheet. Heating in the range of 400 to 600°F (205 to 315°C) caused increased ductility. The fatigue endurance limit was equivalent to the static tensile strength and was found to be improved by etching. Of the tests employed, impact tests provided the best distinctions of the degree of surface damage among the various surfaces. Residual compressive stresses were present at the surface of as-received, ground, and milled sheet. (auth)

25813 CONSTITUTION AND TRANSFORMATION BEHAVIOR OF THE Ti–8Al–8Zr–1(Ta + Cb) ALLOY. Harold Margolin and Elmars Ence (New York Univ., New York). Trans. Am. Soc. Metals, 54: 158-67 (June 1961).

The constitution, cold working and aging behavior of the Ti–8Al–8Zr–1(Ta + Nb) alloy was undertaken in an attempt to obtain some understanding of the reasons for the instability of 8–8–1 fasteners exposed to elevated temperatures and stress. The constitution was found to be in agreement with recent work on the Ti–Al system and readily discernible structural changes correlatable with hardness were noted after working at room temperature and after elevated temperature exposure. (auth)

25814 PHASE EQUILIBRIA IN THE YTTRIUM–ALUMINUM SYSTEM. Charles E. Lundin, Jr. and Donald T. Klodt (Univ. of Denver). Trans. Am. Soc. Metals, 54: 168-75 (June 1961).

The phase equilibria of the binary alloy system, yttrium–aluminum, were investigated by microscopic, incipient-melting, and x-ray diffraction techniques. The mutual solid solubilities at the terminal ends of the system are less than 0.1 wt %. Three eutectics exist at 9.0, 18.7, and 90.0 wt % Al, and at 970 (1778°F), 1085 (1985°F), and 650°C (1202°F), respectively. Three peritectically formed intermediate phases were identified from microscopic and x-ray diffraction data as Y_2Al (13.2 wt % Al), YAl (23.3 wt % Al), and YAl_3 (47.6 wt % Al) which decompose at approximately 1025 (1877°F), 1165 (2129°F), and 1355°C (2471°F), respectively. Two intermediate phases are formed congruently at the stoichiometric ratios, Y_3Al_2 (16.8 wt % Al) and YAl_2 (37.8 wt % Al), and melt at 1090 (1994°F) and 1455°C (2651°F), respectively. (auth)

25815 LIQUID-METAL FUEL CONSTITUTIONS. IV. EFFECTS OF ALKALI METALS ON THE SOLUBILITY OF URANIUM IN BISMUTH. D. G. Schweitzer and J. R. Weeks (Brookhaven National Lab., Upton, N. Y.). Trans. Am. Soc. Metals, 54: 201-7 (June 1961). (BNL-5156)

The effects of alkali metal impurities on the U-Bi liquidus were investigated. Small additions of Na, K, and Cs increased the U solubility; large additions of Na decreased it. The solubility increase was not directly proportional either to the relative electronegativities or to the relative atomic diameters of the alkali metals. The greatest observed solubility increase (45% at 450°C) was observed when 0.6 wt % K was added to the Bi. (auth)

25816 PREDICTION OF ATOMIC MOBILITY IN METALLIC SYSTEMS. Oleg D. Sherby and Massoud T. Simnad (Stanford Univ., Calif. and General Atomic Div., General Dynamic Corp., San Diego, Calif.). Trans. Am. Soc. Metals, 54: 227-40 (Sept. 1961).

The rate of volume self diffusion in metallic systems appears to be predictable by the formula $D = Do \times e^{-(Ko + V)(Tm/T)}$ where Do is a universal constant about equal to 1 cm^2/sec, Tm is the absolute melting temperature, T is the absolute temperature of diffusion, V is the valence of the metal, and Ko is a crystal structure factor (14 for BCC metals, 17 for FCC and HCP metals, and 21 for diamond-structure type metals). Theoretical implications of this empirical equation for diffusion are discussed. (auth)

25817 METALLOGRAPHIC STUDIES OF Al–Ni–U BONDS IN NUCLEAR FUEL ELEMENTS. C. L. Angerman (E. I. du Pont de Nemours and Co., Aiken, S. C.). Trans. Am. Soc. Metals, 54: 260-75 (Sept. 1961).

The diffusion zones that occur in as-bonded fuel elements were identified by correlating the appearances of the zones with similar zones in diffusion couples that were identified by metallography and x-ray diffraction. The two aluminum-nickel zones in the bonded fuel elements were identified as Al_3Ni and Al_3Ni_2, and the two nickel-uranium zones were identified as U_6Ni and UNi_5. An oxide, believed to be either UO_2 or a U–Ni–O ternary compound, was observed either as a dispersed phase within the UNi_5 zone or as a continuous layer between the U_6Ni and UNi_5 zones. The dispersed form of the oxide was observed to coalesce into a continuous layer and finally to dissolve during prolonged annealing. The limiting factor in the quality of the bonds was the presence of this oxide within the Ni-U portion of the bond. When the oxide occurred as a continuous layer the strength of the bond averaged less than 10,000 psi and the bond was rapidly undercut during the pinhole corrosion test. When the oxide occurred as dispersed particles the strength averaged greater than 15,000 psi and the bond confined corrosion. (auth)

25818 HARDNESS ANISOTROPY OF COLUMBIUM. D. L. Douglass (General Electric Co., Pleasanton, Calif.). Trans. Am. Soc. Metals, 54: 322-30 (Sept. 1961).

The Knoop hardness of niobium single crystals varied considerably with both the crystal plane tested and the orientation of the indenter within the plane. The periodicity of the variation with respect to indenter orientation was a function of the crystal plane and varied from $\frac{1}{2}$ to 3 over 180° rotation of the indenter. Crystals having a periodicity of 3 were located near the [111] corner of the unit stereographic triangle and corresponded with the threefold symmetry of [111] orientations. The hardness data for (110) and (111) crystals were expressed in terms of an effective resolved shear stress on those planes and gave good agreement for {112} ⟨111⟩ and {110} ⟨111⟩ slip, respectively. The (110) crystal results did not agree with calculated orientations for maximum resolved shear by Opinsky and Smoluchowski (6). It was concluded that the complex state of stress existing and the multiplicity of possible slip systems operative during hardness testing limit evaluation of the deformation to a qualitative basis. (auth)

25819 PHASE RELATIONSHIPS IN THE NICKEL–ZIRCONIUM AND NICKEL–HAFNIUM ALLOY SYSTEMS. M. E. Kirkpatrick and W. L. Larsen (Ames Lab., Ames, Iowa). Trans. Am. Soc. Metals, 54: 580-90 (Sept. 1961).

The phase diagram for the nickel–zirconium alloy system was established through solidus and liquidus temperature determinations, temperature vs resistance measurements, metallographic examinations and x-ray diffraction investigations and is presented. The intermediate phases $Ni_{11}Zr_9$, $Ni_{10}Zr_7$, Ni_5Zr_2, and Ni_5Zr were formed peritectically at 1170 (2138°F), 1160 (2120°F), 1180 (2156°F), and 1300°C (2372°F), respectively. The phases $NiZr_3$, NiZr, and Ni_7Zr_2 melted congruently at 1110 (2030°F), 1240 (2264°F), and 1410°C (2570°F), respectively. Crystallographic data

for several of these intermediate phases are presented. The intermediate phases which form in the nickel-hafnium system are equivalent to the corresponding nickel-zirconium phases in that their compositions, modes of formation and crystal structures are analogous. (auth)

25820 EFFECT OF ZIRCONIUM AND HAFNIUM TERNARY ADDITIONS ON THE TENSILE AND CREEP PROPERTIES OF TITANIUM–ALUMINUM ALLOYS. A. G. Imgram, D. N. Williams, and H. R. Ogden (Battele Memorial Inst., Columbus, Ohio). Trans. Am. Soc. Metals, 55: 202-13(Mar. 1962).

The strength of titanium-aluminum alloys increased with increasing aluminum content up to at least 6.5 wt% Al. Increasing the Al content from 6.5 to 8 wt% had relatively little effect on strength, but improved ductility. Heat treatment had no pronounced effect on these alloys. The Ti-8 Al alloy exhibited better creep resistance than the Ti-6.5 Al alloy, but was unstable during creep. Ternary Zr and Hf additions increased the strength and improved the ductility of Ti-Al alloys. Higher creep resistances with stability were obtained with ternary additions of Zr and Hf than could be obtained with binary Ti-Al alloys. In general, however, instability of Ti-8 Al alloys could not be retarded by ternary additions of Zn and Hf. (auth)

25821 STORED ENERGY AND RELEASE KINETICS IN LEAD, ALUMINUM, SILVER, NICKEL, IRON, AND ZIRCONIUM AFTER DEFORMATION. Robin O. Williams (Oak Ridge National Lab., Tenn.). Trans. Met. Soc. AIME, 224: 719-26(Aug. 1962).

The increase in internal energy as the result of deformation was measured for Pb, Al, Ag, Ni, Fe, and Zr by using rapid, adiabatic compression. The stored energy increase was roughly proportional to the strain; the proportionality constant increased rapidly with increasing melting point. The fraction of the mechanical energy which was stored increased more slowly, since the strength of the metals also increased with melting point. The values of the stored energy were considered accurate to about 10%. The values appeared about 50% larger than the more reliable published results where comparisons are possible. This difference may be due to the high strain rate used in the investigation. Immediately after deformation, all these metals released energy at a rate roughly proportional to $(\text{time})^{-2}$. This release was considered to be associated with dislocation motion, but in aluminum and copper some additional process seemed to be present. This release can represent 20% or more of the stored energy. (auth)

25822 DILUTE ALLOYING EFFECTS ON RECRYSTALLIZATION IN NICKEL AS COMPARED WITH OTHER TRANSITION ELEMENT SOLVENTS. E. P. Abrahamson, II. (Watertown Arsenal Lab., Mass.). Trans. Met. Soc. AIME, 224: 727-32(Aug. 1962).

The effect of transition element binary solid solution additions upon the recrystallization temperature of nickel was investigated. All additions raised the recrystallization temperature. Both the rate of change of recrystallization temperature with at. % solute and the limit of initial linearity were found to correlate with the free atom ground state outer electron configuration of the solute element. A comparison of all of the correlations for the transition elements studied yielded a set of empirical relations, which allows the prediction of the effect of dilute binary transition elements on the recrystallization temperature of other transition elements. (auth)

25823 THE TANTALUM–ZIRCONIUM ALLOY SYSTEM. D. E. Williams, R. J. Jackson, and W. L. Larsen (Ames Lab., Ames, Iowa). Trans. Met. Soc. AIME, 224: 751-6(Aug. 1962). (IS-320)

The phase diagram of the Ta-Zr system is presented with a discussion of the methods used in its determination. The solidus contains a minimum at 1820°C near 25 wt % Ta. A complete solid solution exists at elevated temperatures between tantalum and β zirconium. This solid solution decomposes monotectoidally at 800°C and 12 wt % Ta. The maximum solubility of tantalum in a zirconium is slightly less than 2 wt %, and decreases with decreasing temperature. The solubility of zirconium in tantalum is 5 wt % at the monotectoid temperature and about 2 wt % at room temperature. (auth)

25824 Sc–Ti SYSTEM AND THE ALLOTROPY OF Sc. B. J. Beaudry and A. H. Daane (Iowa State Univ., Ames). Trans. Met. Soc. AIME, 224: 770-5(Aug. 1962). (IS-310)

The Sc–Ti system was studied by thermal, metallographic, and x-ray methods. Scandium was found to transform at 1334°C from α (hexagonal) to β which was concluded to be bcc since a continuous series of solid solutions if formed between β scandium and β titanium at elevated temperatures. There is a minimum in the solidus at 51 wt % Ti and 1300°C, a monotectoid at 1050°C and 49 wt % Ti, and a eutectoid at 875°C and 91.5 wt % Ti. The maximum solubility of titanium in α scandium is 13.5 wt % at the monotectoid temperature, while the maximum solubility of scandium in α titanium is 6.5 wt % at 875°C. (auth)

25825 THE DENSITY OF LIQUID IRON FROM THE MELTING POINT TO 2500°K. A. D. Kirshenbaum and J. A. Cahill (Temple Univ., Philadelphia). Trans. Met. Soc. AIME, 224: 816-19(Aug. 1962).

Using an alumina or zirconia crucible with an alumina sinker or a molybdenum sinker coated with zirconium dioxide, the density of liquid iron was determined by the immersed-sinker method over the temperature range of 1800 to 2500°K. The density, with respect to temperature, is expressed by the equation $D_{g/cm^3} = 8.523 - 8.358 \times 10^{-4}$ T°K. The molar volumes and thermal coefficients of expansion were calculated. Iron, upon melting, was found to expand 3.5%. (auth)

25826 THE SYSTEM MOLYBDENUM–TITANIUM–ZIRCONIUM–OXYGEN AT 1500°C. Michael Hoch and Michel Desjardins (Univ. of Cincinnati). Trans. Met. Soc. AIME, 224: 821-6(Aug. 1962).

The isothermal section of the Mo–Ti–Zr–O system at 1500°C was investigated using x-ray diffraction and metallographic techniques. Up to 66.7 at. % O, the system contains ten four-phase regions. Isopleths at 10, 30, 45, 55, and 60 at. % O were constructed. (auth)

25827 PRECIPITATION OF LAVES PHASES FROM IRON–NIOBIUM (COLUMBIUM) AND IRON–TITANIUM SOLID SOLUTIONS. G. R. Speich (U. S. Steel Corp., Monroeville, Penna.). Trans. Met. Soc. AIME, 224: 850-8 (Aug. 1962).

The precipitation of the Fe_2Nb and Fe_2Ti Laves phases ($MgZn_2$ type, C14) from Fe–Nb and Fe–Ti solid solutions, respectively, was studied in the temperature range 500 to 800°C using hardness measurements, light and electron microscopy, and x-ray and electron diffraction. The Fe–Nb alloys contained 0.96, 1.67, and 3.80% Nb and the Fe–Ti alloys 3.5, 5.8, and 8.8% Ti. In both systems only the equilibrium Laves phase is formed, with nucleation occurring at grain boundaries, at dislocations, and in the matrix. No cellular precipitation or transition phases were observed. The precipitation of the Laves phase in a fine dispersion leads to significant hardening in both systems. The hard-

ness of the aged alloys is proportional to the reciprocal of the square root of the interparticle spacing. The maximum solid solubility of titanium in α iron is 9.0% Ti at 1280°C. (auth)

25828 THE CRYSTAL STRUCTURES OF TiCd AND Ti_2Cd. R. V. Schablaske, B. S. Tani, and M. G. Chasanov (Argonne National Lab., Ill.). Trans. Met. Soc. AIME, 224: 867-8(Aug. 1962).

In the Ti-Cd system two intermediate phases, TiCd and Ti_2Cd were found and characterized by x-ray diffraction powder techniques. Studies of the solubility of titanium in liquid cadmium led to the discovery of both TiCd and Ti_2Cd. The solid phase in equilibrium with saturated solutions of titanium in liquid cadmium at temperatures below 620°C is TiCd, whereas Ti_2Cd is the equilibrium solid phase above 620°C. (M.C.G.)

25829 VERIFICATION OF Fe–Zr ALLOY EQUILIBRIUM PHASE DIAGRAMS. V. N. Svechnikov and A. Ts. Spektor. Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S. S. R., Sbornik Nauch, Rabot, No. 11, 30-5(1960). (In Russian)

Differential thermal, high-temperature dilatometric, and differential dilatometric analyses and the emf method were used for determining the phase diagram of Fe–Zr alloy. The microanalysis of pre-eutectic, eutectic, and post-eutectic alloys were studied during slow cooling and at 1300, 1330, and 1350°C annealing temperatures. The results are tabulated for partial phase equilibrium with up to 30% Zr. A new temperature for tri-phase equilibrium γ-iron-δ, or the second melting point, was found at 1345°C. The eutectic melting point was found at 1320°C (instead of 1330°) indicating a 25° interval between the eutectic and second melting points. The diffusion of Zr in γ-phase iron at the eutectic melting point was ~1.0%, however, further studies are required for verification. (R.V.J.)

25830 FORMATION OF ω-PHASE IN Ti ALLOYS. V. N. Gridnev, Yu. N. Petrov, V. A. Rafalovskii, and V. I. Trefilov. Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch, Rabot, No. 11, 82-6(1960). (In Russian)

Formation of the ω phase in Ti-Cr and Ti-Fe alloys was studied. The ω phase appeared during the annealing of alloys with 5 and 8% Cr and 5% Fe; in alloys with 12% Cr and 8% Fe the β phase was observed at room temperature; at 250 to 350°C the metastable β phase disintegrated into ω phase with Cr-enriched β phase, reduced Δl volume, and increased hardness. The $\beta \rightarrow \omega$ transformation mechanism was studied as a martensite diffuseless transformation and as a metastable solid solution with intermediate ω phase. (R.V.J.)

25831 EFFECTS OF CRYSTAL STRUCTURE ON DIFFUSION PARAMETERS IN NICKEL ALLOYS. I. Ya. Dekhtyar and V. S. Mikhalenkov. Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch, Rabot, No. 11, 106-16(1960). (In Russian)

Diffusion in plastically deformed Ni-Mo with 6.5, 9.6, and 16.7 at. % Mo and in stainless steel ferrites were studied, using Co^{60} and Fe^{59}, at 950, 1050 and 1150°C and 900 and 1000°C, respectively. Diffusion diagrams, constructed as functions of deformation rate, are analyzed. (R.V.J.)

25832 HEATS OF FORMATION OF URANIUM SILICIDES AND NITRIDES. Phillip Gross, Colin Hayman, and Hilary Clayton (Fulmer Institute Ltd., Stoke Poges, Eng.). Preprint SM-26/7. 17p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

The standard heats of formation of the uranium silicides U_3Si_2, USi, USi_2, and USi_3 were determined by measuring the heats evolved in the direct combination of the elements. The heats of formation of the last three were checked by measuring the heats of reaction of tellurium with the preformed compounds and comparing them with those obtained from reacting equivalent quantities of the uncombined elements with tellurium. The heat of formation of uranium mononitride (UN) was determined by measuring the heat evolved in the reaction between an excess of uranium powder and a known amount of nitrogen. The heat of formation of uranium sesquinitride (U_2N_3) was determined by measuring the heat evolved in the reaction of an excess of uranium mononitride with a measured amount of nitrogen. Experiments on the dissociation pressure of uranium sesquinitride are reported. (auth)

25833 THERMODYNAMICS OF HIGH MELTING URANIUM AND THORIUM COMPOUNDS. HIGH MELTING SYSTEMS WITH BORON, CARBON, AND NITROGEN. E. Rudy (Metallwerk Plansee AG., Reutte/Tyrol, Austria). Preprint SM-26/58. 25p. (In English)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

An important factor for the choice of materials for use as fuel inserts in high temperature reactors constitutes their compatibility toward the immediate surrounding at operating conditions. Many of the thermodynamical data of interesting phases known at present are not reliable or have have not been yet determined. This is partly due to the great experimental difficulties involved in direct high temperature calorimetric measurements. Experimental determined phase equilibria provide a good means in deriving free energies of formation of certain compounds. The basic equations for the setup of phase equilibria in multicomponent systems are derived by means of the Lagrangian theorem, using the postulate of the minimum of the integral free energy. The resulting equations are applied to various ternary uranium and thorium systems (e.g., U–Zr–C, U–Hf–C, U–Nb–C, U–Ta–C, U–Mo–C, U–W–C, Th–U–C, Th–Zr–C, Th–Mo–C, Th–W–C) and the data obtained are compared with the values given in the literature. The data, as derived from phase relationships, may be used to predict phase equilibria in multicomponent systems and the change of equilibria with temperature, facilitating therefore significantly the choice of proper alloy combinations for the desired purpose or intended experimental investigations. (auth)

25834 HEAT OF FORMATION OF INTERMETALLIC COMPOUNDS OF PLUTONIUM WITH ALUMINIUM AND IRON AND OF URANIUM WITH IRON. V. V. Akachinskii, L. M. Kopytin, M. I. Ivanov, and N. S. Podolskaya. Preprint SM-26/59. 13p. (In Russian)

To be published in the Proceedings of the IAEA Symposium on the Thermodynamics of Nuclear Materials held in Vienna, 21-25 May 1962.

Results are described of work on the determination of the heat of formation of intermetallic compounds in the Pu–Al, Pu–Fe, and U–Fe systems, derived by the dissolution calorimetry method. The methods of derivation of the compounds, the determination of their composition, and the calorimeters employed differed between uranium and plutonium. (auth)

25835 ANALIZ TVERDYKH TUZOPLAVKIKH SPOLUK. (Analysis of Hard High-melting Alloys). G. V. Samsonov,

A. T. Pilipenka, and T. M. Nazarchuk, eds. Kiev, Publishing House of Ukrainian Academy of Sciences, 1961. 196p. (In Ukrainian)

An analysis was made of hard, high-melting carbides, silicides, borides, and nitrides. Physical and chemical properties and industrial applications are reviewed. Methods for determining individual metal components in the systems are discussed. 404 references are included. (R.V.J.)

Radiation Effects

Refer also to abstracts 26492, 26493, and 26494.

25836 (AD-270724) NUCLEAR PULSE TESTING OF VIDICON AND IMAGE ORTHICON CAMERA HEADS. Memorandum Report M62-10-1. Thomas F. Kothstein (Frankford Arsenal, Philadelphia). Oct. 1961. 27p.

Results are reported of nuclear pulse irradiation tests on two electrovisual subsystems: a vidicon camera head with preamplifier, and an image orthicon camera head. Both were fully energized when subjected to several combined neutron and gamma pulses having half-power pulse widths of 15 milliseconds. A fully operating nuvistorized vidicon camera head was exposed to a total of ten nuclear pulses, each pulse containing integrated fluxes of 2.21×10^{14} neutrons/cc (1 kev and above) and 100,000 r (gamma). No permanent degradation of the system performance factors was detected other than the lowering of signal-to-noise ratio caused by the browning of the vidicon faceplate. The fully energized but nontelevising image orthicon was exposed to three nuclear pulses. Photocathode and beam currents were monitored through each pulse and sensitivity information gained in this manner. Further tests proved that physical change in the photocathode resulted in a definite deterioration of the image orthicon photosensitivity. The faceplate and photocathode received a dose of 1.29×10^{14} neutrons/cc and approximately 100,000 r (gamma) per burst. (auth)

25837 (AD-270841) STUDY OF THERMAL PROPERTIES OF REFRACTORIES. Quarterly Progress Report No. 2. R. E. Taylor and M. M. Nakata (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 1962. Contract AF33(657)-7136. 20 p. (AI-7034)

A status report is presented on the development of the transient thermal property apparatus. Refinements of the apparatus were described and results of measurements are given for the thermal diffusivity of Ta at 1300 to 1650°C and for the diffusivity of ZrC at 1300 to 1600°C. The status of thermal property measurements by existing techniques is included. Results of thermal conductivity measurements of ZrC at 450 to 1820°C and of the specific heat of TiC at 100 to 730°C are reported. (auth)

25838 (ARF-1184-5) MAGNETIC PROPERTIES OF INSULATORS. Quarterly Report No. 5, February 15, 1962 to May 15, 1962. Jordan J. Markham (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 29, 1962. Contract AT(11-1)-578. 34p.

Initiation of a study on the recovery time and shape of the hole which can be burned into the resonance absorption is reported. Continued detailed study of various nuclear and electronic relaxation mechanisms is also reported. Optical work was carried out to develop skills for use in preparing crystals which are useful in EPR investigations. KCl is being used as a preliminary step to the preparation of RbCl crystals. Data obtained in thermal treatments of K-metal additively colored KCl crystals are given along with data on the effects of x-ray bleaching on similar crystals. A paper on the Einstein A and B coefficient for a point imperfection is included. (J.R.D.)

25839 (BMI-X-197) DEVELOPMENT OF URANIUM MONONITRIDE. Quarterly Progress Report for January–March 1962. Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 10p. (EURAEC-348)

Ten 96 to 97% dense UN rods for phase-study specimens were fabricated by isostatic hot pressing. UN powder hydrostatically cold pressed at 100,000 psi without binder to a density that was 71 to 74% of theoretical yielded compacts strong enough to be roughly handled. Experimental variables in the irradiation program were selected to permit an evaluation of the effect of both fuel burnup and the $N^{14}(n,p)C^{14}$ reaction on the stability of UN. Specimens of UN containing 0.224, 0.720, and 4.98% U^{235} were irradiated. The volume of hydrogen produced in the specimens as a result of the (n,p) reaction was a function only of integrated neutron flux, while the fuel burnup was a function of both uranium enrichment and integrated neutron flux. The design and assembly of a high-temperature controlled-pressure apparatus for use in phase studies of the uranium-nitrogen system were begun. (M.C.G.)

25840 (HW-65453) URANIUM SWELLING STUDIES: CONSTANT TEMPERATURE IRRADIATION CAPSULE. B. S. Kosut and R. D. Leggett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1961. Contract AT(45-1)-1350. 18p.

A capsule is described that was designed to maintain uranium at a constant temperature during neutron irradiation. The capsule design proved to be a rugged, dependable device and the only one of its kind that provided excellent temperature control on fissionable material for long periods of time regardless of reactor operating conditions. The general mode of operation and a detailed description of the capsule components and their assembly are provided. Also included is a brief discussion of the heat transfer concepts employed, and the bench-testing procedures used. The capsule and auxiliary apparatus described is being used in conjunction with a study to determine the basic causes of swelling (increase in volume) in uranium as a consequence of irradiation at elevated temperatures. (auth)

25841 (HW-72321) FISSION PRODUCT RELEASE FROM URANIUM—EFFECT OF IRRADIATION LEVEL. R. K. Hilliard and D. L. Reid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 20, 1962. Contract AT(45-1)-1350. 53p.

An experimental study was made to determine the influence of burnup on the fractional release of fission products from uranium metal at elevated temperatures. Neutron irradiation levels were varied from 2×10^{14} nvt (6.7×10^{-4} Mwd/t) to 4×10^{20} nvt (1340 Mwd/t) while all other conditions remained constant. Metal temperatures explored were 1000, 1200, and 1440°C. Bare uranium cylinders weighing approximately 12 grams were heated out-of-reactor and the liberated fractions of ten fission products plus uranium, plutonium, and neptunium were measured. The variation of the fractional releases of iodine, xenon, and cesium with irradiation level was shown, as was the invariance of the release of certain other elements with burnup. The uranium oxidation rate was found to increase with irradiation levels above 10^{18} nvt. (auth)

25842 (LAMS-2706) RADIATION EFFECTS ON SEMICONDUCTOR DEVICES. Carroll Sue Schwiening, comp. (Los Alamos Scientific Lab., N. Mex.). Apr. 30, 1962. Contract W-7405-eng-36. 72p.

Reference (155) are given to patents, theses, reports, journals, and conference papers published from August 1949 through November 1961. Special emphasis is placed on Van Allen belt radiations and neutron damage. Entries are arranged alphabetically by author. (P.C.H.)

25843 (NARF-62-5T) EFFECTS OF REACTOR RADIATION ON THE ENGINEERING PROPERTIES OF ELASTOMERS AND PLASTICS. J. B. Wattier, D. M. Newell, and L. L. Morgan (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). June 1962. Contract AF 33(657)-7201. 113p. (FZK-9-174)

An analysis of the effects of radiation on the properties of certain elastomers and plastics is summarized. Irradiations were conducted at various temperatures in a variety of media. Information is limited to data on sheet-stock elastomers and plastics. (auth)

25844 (NP-11656) MONTHLY ACCESSION LIST NO. 57 [ON RADIATION EFFECTS DATA], APRIL 1–APRIL 30, 1962. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). May 15, 1962. Contract AF33(616)-7375. 34p.

A list of about 80 articles accessioned and some which were extracted and placed in the REIC files during the period is presented. (J.R.D.)

25845 (NP-11759) FEASIBILITY STUDY TOWARD DEVELOPMENT OF RADIATION RESISTANT SOLAR CELL. Monthly Report, May 1 through May 31, 1962. S. Kaye (Electro-Optical Systems, Inc., Pasadena, Calif.). June 15, 1962. Contract NAS7-92. (EOS-2080-ML-7)

Irradiation of solar cells by 1-Mev electrons and 95.5-Mev protons indicated that cells with a graded base structure are more radiation resistant than typical n or p cells without such structure. The basic mechanism responsible for this performance was not established. (J.R.D.)

25846 (NP-11929) RADIATION EFFECTS ON COAXIAL CABLES AND INSULATION: AN ANNOTATED BIBLIOGRAPHY. William L. Hollister, comp. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Apr. 1962. Contract AF 04(647)-840. 36p. (SB-62-12)

Seventy-five references on the effects of mixed reactor radiation on transients and damage effects in both coaxial cables and electric insulation materials are given to reports, journals, and conferences published from August 1952 to 1961. Items are arranged alphabetically by author. (P.C.H.)

25847 (ORNL-3114) OPTICAL EMISSION FROM IRRADIATED THIN METALLIC FOILS. A. L. Frank, E. T. Arakawa, R. D. Birkhoff, R. H. Ritchie, and H. B. Eldridge (Oak Ridge National Lab., Tenn.). July 18, 1962. Contract W-7405-eng-26. 93p.

Thin metallic foils were irradiated with a 15 microampere beam of electrons from an accelerator operating between 50 to 115 kev. The light emission spectrum from the foils was analyzed with a Seya-Namioka Vacuum UV Monochromator with an EM1 6256B photomultiplier tube as detector. The metals irradiated with silver, aluminum, and gold with the former being unbacked and the latter two supported on thin organic substrates. The silver and aluminum data were compared with previously derived theories for the emission of radiation from a dielectric. Substantial agreement was found between theory and the measurements. (auth)

25848 (ORNL-3275) RADIATION-INDUCED SINTERING OF THORIA POWDERS. J. P. McBride and S. D. Clinton (Oak Ridge National Lab., Tenn.). Aug. 3, 1962. Contract W-7405-eng-26. 18p.

Two series of thorium oxide powders fired at 650, 800, 900, 1100, and 1500°C were irradiated dry in aluminum capsules for 16 and 22 months. The 650, 800, and 900°C fired oxides became red and sintered into hard, glossy fragments. The 1100°C fired materials formed off-white, chalky plugs and the 1500°C fired oxides were blue powders. Specific surface areas of oxide fired at <1100°C were markedly decreased by the irradiation although the estimated maximum temperatures of the powders during irradiation were less than 1000°C. Little or no sintering and only slight particle damage occurred in the 1500°C fired powders. The sintering probably resulted from recrystallization processes induced by fission fragment irradiation. (auth)

25849 (PAN-314/I-B) RADIATION DAMAGE AS A METHOD FOR STUDY OF ELECTRICAL CONDUCTIVITY, HALL-COEFFICIENT AND THERMOELECTRIC POWER OF GERMANIUM AS FUNCTIONS OF CARRIER CONCENTRATION. Bronisław Buras, Maria Bartenbach, Jan Suwalski, and Zenon Tomczak (Polish Academy of Sciences, Inst. of Nuclear Research, Warsaw). Apr. 1962. 19p.

Lattice defects produced by fast neutron bombardment introduce localized energy states into the forbidden band. This changes the carrier concentration and transforms n-type germanium into p-type. In low initial electron concentration in n-type, a small dose is sufficient to cause passage through the intrinsic region of conductivity. The passage takes place with negligible changes in carrier mobility. This in turn enables one to perform continuous simultaneous measurements of various parameters of germanium in the intrinsic region as functions of carrier concentration. Facilities for such in-pile measurements of electrical conductivity, Hall coefficient, and thermoelectric power are described. The measurements allow calculations to be made of the concentration and mobility of light holes and prove that the number of minima in the conduction band of germanium equals four. The internal consistency of the parameters in the carriers (electrons, normal holes, and light holes) is also shown. (auth)

25850 (PAN-315/I-B) SCATTERING OF HOLES IN GERMANIUM BY LATTICE DEFECTS PRODUCED BY FAST NEUTRON BOMBARDMENT. Jan Suwalski and Wiktor Malinowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Apr. 1962. 14p.

A continuous in-pile measurement at constant room temperature of the Hall-coefficient of p-type germanium as a function of fast neutron dose irradiation (up to 2.10^{18} n/cm^2) and magnetic field (from 1 to 9 kOe) was performed. The use of a weak and a strong magnetic field has enabled to distinguish the roles played by the normal and light holes. It was shown that the changes in mobility of the light holes due to fast neutron irradiation are more pronounced than those for the normal ones. The experimental curves (hole mobility vs. magnetic field) for various irradiation doses were compared with those calculated on the basis of the Conwell-Weisskopf formula and the results of other authors. This comparison has led to the conclusion that the defects represent single rather than double charged scattering centers and enables one to discuss the scattering process. (auth)

25851 (PAN-316/I-B) RECOMBINATION-TRAPPING PROPERTIES OF CENTRES INTRODUCED INTO GERMA-

NIUM THROUGH BOMBARDMENT WITH REACTOR FAST NEUTRONS. Jerzy Piekoszewski and Andrzej Czachor (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Apr. 1962. 13p.

The recombination effects in n-type germanium irradiated with fast neutrons were investigated. These effects were due to an increase in carrier lifetime following a decrease in temperature in the low temperature region and a larger increase of lifetime highs than is usually observed following an increase in temperature in the high temperature region. An interpretation of experimental results was provided by a model of centers with many charge conditions with two levels in the forbidden zone, recombination $E_{ex} - E_v \simeq 0.33$ ev, and trapping $E_c - E_1 = 0.20$ ev. (auth)

25852 (PAN-318/I-B) IN-PILE THERMOELECTRIC POWER MEASUREMENTS OF GERMANIUM BOMBARDED BY FAST NEUTRONS. Maria Bartenbach, Zenon Tomczak, and Jerzy Kołodziejczak (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Apr. 1962. 12p.

The thermoelectric power and electrical conductivity of germanium bombarded by fast neutrons in the reactor at Swierk were measured simultaneously as functions of the irradiation time in the neighborhood of the intrinsic region of conductivity. On the basis of the experimentally found dependence of electrical conductivity versus irradiation time, and using the theory of thermoelectric power, the dependence of the thermoelectric power versus time of irradiation was calculated and compared with experiment. A good agreement was found indicating the internal consistency of the theory of thermoelectric power and conductivity. Some evidence was found to support the number of minima in the conduction band of germanium as four. (auth)

25853 (TID-16273) EFFECT OF RADIATION ON DYNAMIC PROPERTIES OF HIGH POLYMERS. Progress Report, July 1, 1961 to June 30, 1962. J. A. Sauer (Pennsylvania State Univ., University Park). July 1, 1962. Contract AT(30-1)-1858. 15p.

New information on radiation effects was obtained for polystyrene, polyethylene terephthalate, polytetrafluoroethylene, polypropylene, and epoxy resins. Proton magnetic resonance techniques were used to study temperature induced molecular motion in paraffins and polyethylene, and in a variety of polymers and monomers, including those containing α-methyl groups and α-olefins. Dielectric studies were completed on various polyamides and some unusual irradiation effects noted. Effects of various factors on transitions in high polymers were explored both by dynamic mechanical techniques and by NMR and some interesting low temperature transitions discovered in the region below 80°K. Thermal conductivity measurements of polymers over a wide temperature range were inaugurated and investigations of methods of preparation and of properties of polymer single crystals were continued. Installation of temperature and humidity controls has allowed improved precision in measurement of dielectric and thermal expansion properties of polymers at low temperatures. A list of publications and graduate theses is included. (auth)

25854 (WAPD-TM-336) THE PROPERTIES OF HAFNIUM FROM A PWR CORE I CONTROL ROD AFTER ONE SEED LIFE EXPOSURE. G. J. Salvaggio (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1962. Contract AT(11-1)-Gen-14. 35p.

A PWR control rod that was irradiated to 3.85×10^{21} nvt (>0.625 ev) during one seed life in the Shippingport Atomic Power Station was destructively tested in an effort to determine the effect of irradiation on the properties of hafnium. Tests performed included hardness, tensile strength, density, and electrical resistivity; results of these tests indicated that hardness and strength were increased, useful ductility was decreased slightly, and density and electrical resistivity were not changed significantly. It was concluded, therefore, that hafnium is adequate for continued use through several seed lives in PWR. (auth)

25855 THE IRRADIATION RESISTANCE OF ORGANIC INSULATING MATERIALS. F. B. Waddington (AEI Research Lab., Manchester, Eng.). AEI (Assoc. Elec. Ind.) Eng., 2: 24-9(Jan.-Feb. 1962).

A 4-Mev electron facility capable of producing dose rates up to several Mrad/min for studies of irradiation effects on organic materials used as electric insulators is described. Experimental results for several general types of materials (solid moulding materials, rubbers and elastomers, varnishes, liquids, and gases) are reviewed. The correlation of electron damage with damage by other types of radiations is shown, and the effect of dose rate on damage is discussed. The facility is designed for studies on manufactured components, in addition to studies on bulk materials. (T.F.H.)

25856 EFFECTS OF IRRADIATION ON SLIP-CAST FUSED SILICA. J. D. Fleming (Georgia Inst. of Tech., Atlanta). Am. Ceram. Soc. Bull., 41: 472-3(July 15, 1962).

Slip-cast silica was irradiated for 340 megawatt days. The fast dose of approximately 4×10^{20} nvt resulted in essentially complete destruction of the cristobalite present. No statistical change in transverse strength of the silica was noted. (auth)

25857 THE INFLUENCE OF RADIATION ON THE PROPERTIES OF PIEZOELECTRIC RESONATORS. K. Kratochvílová, J. Tichý, and J. Zelenka. Československ. časopis pro fysiku, 12: 144-51(1962). (In Czech.)

Existing knowledge on the action of radiation, particularly x rays, γ rays, and neutrons, on the properties of piezoelectric resonators is reviewed. The actual results of measuring the influence of x-rays on the temperature dependence of the frequency of thickness-shear vibration of quartz resonators of AT and BT orientation and on the frequency of the first and third type of extensional mode of vibration of DKT resonators of XZ and 37°30′ orientation are given. In conclusion, attention is drawn to some important problems which should be solved in the future. (auth)

25858 BEHAVIOR OF EXPLOSIVES UNDER GAMMA IRRADIATION. NOTE III. Erminio Piantanida and Marcello Piazzi (Istituto di Chimica dell'Accademia Navale, Leghorn). Chim. e ind. (Milan), 44: 247-50(Mar. 1962). (In Italian)

Experimental results relative to the effects of gamma rays on explosives are given. Results of other experiments on smokeless powders made with the purpose of studying the relations between the effect of the gamma irradiation on the contents in centralite are referred. (auth)

25859 THE EFFECT OF GAMMA RADIATION ON THE HEAT STRENGTH OF LOW-CARBON STEEL. I. A. Oding and P. V. Zubarev (Baikov Inst. of Metallurgy, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 325-6(May 11, 1962). (In Russian)

Samples of low-carbon steels containing 0.08% C, 0.05% Si, 0.26% Mn, 0.03% S, and 0.01% P were given a total dose of 17.28×10^6 r from a Co^{60} source. Calculations showed that under the conditions of the experiment 94% of the photons are scattered with a change in wave-length and transfer of part of the energy to the scattering electron (the

Compton effect), 5% of the photons results in the formation of electron-positron pairs, and 1% of the Co^{60} photons remove electrons from the absorbing material (the photoelectric effect). The changes taking place in the metal were partial ionization of the atoms, and especially the formation of Frenkel pairs, that is, of vacancies and dislocated atoms. The increase in strength was insignificant. However, tests on the long-term strength showed that the strength at 450°C at the end of 100 hours increased from 19.2 for the unirradiated sample to 20.7 kg/mm² for the irradiated sample. The service life of the irradiated sample was increased by a factor of about 17. (TTT)

25860 DO FIELD-EFFECT TRANSISTORS RESIST NUCLEAR RADIATION? Alvin B. Kaufman (Litton System, Inc., Woodland Hills, Calif.). Electronics, 35: No. 28, 56; 58(July 13, 1962).

The mutual conductance of Si n-p-n field-effect transistors is measured as a function of epithermal neutron dose up to 10^{14} neutrons/cm², and it is found that the exposure required to reduce the gain to 0.7 times its original value is about 2×10^{13} neutrons/cm². The relative insensitivity of these devices to neutrons is analyzed. It is suggested that majority-carrier characteristics may be the most significant factor in radiation resistance, and that these characteristics may be improved by lowering semiconductor resistivity, efficient surface passivation, and use of Ge in place of Si. (T.F.H.)

25861 RADIATION EFFECTS IN URANIUM-DOPED ZIRCONIA. M. C. Wittels, J. O. Stiegler, and F. A. Sherrill (Oak Ridge National Lab., Tenn.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 16: 237-44(May 1962).

A study concerning the mechanism of the radiation-induced phase transformation, monoclinic to f.c.c., in ZrO_2 is presented. The most important aspect of these experiments was the effort to separate the effects of fast neutrons, fission fragments, and uranium chemical impurities. This was accomplished by careful doping chemically pure ZrO_2 samples with selected concentrations of enriched and depleted uranium, irradiating these samples in closely monitored thermal-neutron and fast-neutron environments and correlating the phase changes observed with the specific particle events, irradiating ZrO_2 that was obtained by oxidizing Zircaloy-2 which was free of fissionable impurities with a fast neutron dose greater than 6×10^{20} n/cm², and subjecting a large group of reactor grade zirconium and its alloys, selected at random, to neutron activation analysis for U and Th impurities. The results of the investigation indicate fission fragment fluxes associated with 10^{15} to 10^{16} fissions/cm³ produce a monoclinic to f.c.c. phase change in ZrO_2, and the presence of U in ZrO_2 in concentrations less than 0.38 wt.% does not act as a nucleation or stabilizing atom in the process, the stability of the phases of ZrO_2 under reactor irradiation depends entirely upon the action of a fission fragment flux of sufficient magnitude, and where conflicting data were reported it is believed that an unknown presence of fissionable impurities would resolve these differences, fast neutrons, solely, cannot induce the phase transition at doses up to 6.3×10^{20} n/cm², in twenty-one analyses for U and Th in randomly selected reactor grade zirconium and its alloys, fissionable impurities were found in twenty cases. Natural uranium concentrations varied between 1.8 and 6.3 ppm, and thorium concentrations varied between 0.29 and 50.0 ppm. Two different models are given to explain the mechanism of fission fragments in producing the phase transition. Both models require the collapse of small regions due to the pressures exerted by interstitials. In one case the action takes place at the beginning of the range of the fission fragment through an ionization displacement process, and in the other instance the process occurs near the end of the fission fragment where elastic collisions predominate. The effects of temperature are not clear and are not of prime importance, but the radiation stability of the fluorite structure of ZrO_2, as in the case of UO_2, appears to be significant. (auth)

25862 THE EFFECTS OF NEUTRON IRRADIATION ON γ-URANIUM AND SOME FISSILE ALLOYS OF CUBIC CRYSTAL STRUCTURE. G. W. Greenwood (Berkeley Nuclear Labs., Berkeley, Gloucester, Eng.). J. Nuclear Materials, 6: 26-34(May-June 1962). (AERE-R-3468). (In English)

Dimensional and density changes and optical and electron microscope observations are reported on neutron-irradiated γ-uranium and on a series of fissile alloys of single phase cubic crystal structure which are not subjected to severe internal stresses of the type occurring in α-uranium on thermal cycling or irradiation growth. The materials of cubic crystal structure showed little change of shape on irradiation though volume increases up to 100% were observed. No radioinduced cracks were found and volume increases were entirely due to bubbles of fission product gases which were nearly spherical except when they were large enough to link together. Average bubble sizes ranged from small fractions of a micron to a few hundred microns. Measurements indicated that surface tension forces provided the chief restraint to bubble growth. For a given burnup and irradiation temperature, volume increases were largely determined by the number of bubbles present. (auth)

25863 ELECTRON MICROSCOPIC STUDY OF DISLOCATIONS AND FISSION DAMAGE IN PLATINUM FOILS. E. Ruedl, P. Delavignette, and S. Amelinckx (Studiecentrum voor Kernenergie, Mol, Belgium). J. Nuclear Materials, 6: 46-68(May-June 1962). (In English)

Thin beaten foils of platinum were investigated by means of transmission electron microscopy. Annealed, as well as annealed and subsequently fission-fragment and α-particle irradiated foils were examined. The annealed foils showed features which are typical for a face centered cubic metal with a medium high stacking fault energy. Prismatic loops with a $\frac{1}{2}a$ [1 1 0] Burgers vector resulted from the irradiation; this could be proved by observing their motion. The loops annealed out at the temperature where according to Piercy vacancies become mobile. Preferential loop formation was noticed at certain boundaries, in particular along coherent twin boundaries. This was considered as evidence that correlated collision chains lead to preferential defect formation at these boundaries by "defocusing" of [1 1 0] focussons. It was noticed that for small doses dislocation loops are not distributed at random in the interior of the grains but show a tendency to be aligned. This was interpreted as resulting of loop nucleation along the path of a fission fragment. After quenching, specimens contained both cavities and loops. The damage rate of quenched specimens seemed to be larger than that of annealed ones; the loop concentration was less along a denuded zone parallel to boundaries and subboundaries. It is suggested that either the vacancy clusters left by quenching are nucleation sites for loops or that the vacancy clusters defocus focussons and hence increase the damage. It is shown that the loops left after irradiation are presumably vacancy loops. (auth)

25864 STORED ENERGY IN IRRADIATED GRAPHITE. EFFECTS OF IRRADIATION TEMPERATURE. J. Rappeneau (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 6: 107-18(May-June 1962). (In French)

Under the influence of neutron irradiation, graphite stores internal energy and various methods of measuring this energy are in current use. Three methods were developed: annealing at constant temperature, semiadiabatic annealing, and differential thermal analysis. After a brief description of these methods, it is shown that the results obtained by them, from similar graphite samples, agree mutually and also with results obtained by others. The effects of irradiation temperature on the amount of energy stored in graphite were studied with reference to samples from the G1 reactors (40 to 150°C) and the G2 reactors (130 to 300°C). Measurements made by means of differential thermal analysis permit the determination of the enthalpy $dH/d\theta$ (cal/g · °C) as a function of the temperature θ between ambient temperature and 800°C, and the integration of the energy spectrum furnishes the total stored energy $H(\theta)$. At a given irradiation temperature, the energy liberated by the irradiated graphite increases proportionally to the irradiation dose. This linear relationship is valid only for small doses. For relatively low irradiation temperatures (30 to 70°C) there is a peak of energy release near 200°C. As the irradiation temperature increases, this energy peak diminishes and it disappears for an irradiation temperature of about 200°C. The amount of energy stored for a constant dose of 2×10^{20} n/cm^2 decreases rapidly as the irradiation temperature increases from 50 to 300°C. The results obtained with graphites irradiated in the G1 and G2 reactors are in good accord with results by other investigators. (auth)

25865 IRRADIATION DAMAGE CLUSTERS IN THE OXIDES OF BERYLLIUM AND MAGNESIUM. D. H. Bowen, R. S. Wilks, and F. J. P. Clarke (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 6: 148-51(May-June 1962). (In English)

Evidence was obtained for the presence of defect clusters in both BeO and MgO by transmission electron microscopy. Polycrystalline BeO and single crystal MgO were irradiated at 150°C to a dose of 3×10^{19} nvt. For MgO, heating at 100°C intervals in the range 300 to 1200°C produced a steady diminution of the damage evidenced by lattice parameter and macroscopic expansion measurements, but detectable loops were not readily distinguishable until 900°C. Annealing above this temperature caused them to increase in size and decrease in numbers. In BeO, the same phenomena as occurred in irradiated MgO on annealing appeared to occur in unirradiated BeO during examination in the electron microscope. Experimental observations led to the conclusion that the production of defects may be resulting from direct collisions between the electrons and lattice atoms. (M.C.G.)

25866 SINGLE PHONON ABSORPTION BANDS IN FAST NEUTRON IRRADIATED SILICON. M. Balkanski and W. Nazarewicz (Laboratoire de Physique de l'Ecole Normale Superieure, Paris). Phys. and Chem. Solids, 23: 573-6(June 1962). (In English)

The infrared absorption spectrum in the range 670-250 cm^{-1} (15-40 μ) of silicon bombarded with fast neutrons was studied, and the absorption bands at 488, 417, and 332 cm^{-1} are attributed to a single phonon absorption process connected with the excitation of the fundamental modes TO, LO, LA, respectively. These fundamental modes become active because of the lattice distortion resulting from the defects produced. The phonon energies measured agree with those calculated by Johnson on the basis of combination band spectra occurring in silicon perfect single crystals and those obtained by using the method of inelastic scattering of neutrons. (auth)

25867 ELECTRON RESONANCE STUDIES ON IRRADIATED SILVER BROMIDE IN RELATION TO THE PHOTOGRAPHIC PROCESS. M. J. A. Smith and D. J. E. Ingram (Univ. of Keele, North Staffordshire, Eng.). Proc. Phys. Soc. (London), 80: 139-42(July 1, 1962).

Electron spin resonance measurements on powdered and melted samples of silver bromide irradiated with x-ray, ultra-violet, or optical light also showed that the irradiation products were colloidal particles of silver metal less than 10^{-4} cm in diameter. The results were discussed in relation to similar experiments on irradiated lithium hydride where the size of the colloidal particles of lithium metal could be calculated. (auth)

25868 CONTACT MELTING OF IRRADIATED CRYSTALS. I. G. Berzina and P. A. Savintsev (Kirov Polytechnical Inst., Tomsk, USSR). Soviet Phys.-Cryst., 7, No. 1, 131-3(July-Aug. 1962). (In English)

It was verified for contact melting that the effects of radiation on the physical properties of a crystal are greater the lower the melting point. The rate V of contact melting was measured to determine the activation energy U by the formula $V = A \exp(-U/RT)$. The pairs used were Sn–In, Sn–Cd, Sn–Bi, Sn–Pb, Bi–Pb, and Bi–Cd. It was found that U increased with temperature for both irradiated and control specimens. Radiation reduced the rate of contact melting on account of migration of defects. Radiation effects on rate were larger for quenched samples. Radiation produced structure defects that increased V and decreased U. (M.C.G.)

25869 Co^{60} GAMMA-RAY INDUCED DEGRADATION OF BUTYL RUBBER AND ITS VULCANIZATES. V. F. Drozdovskiĭ, I. A. Shokhin, and N. A. Klauzen. Vysokomolekulyarnye Soedineniya, 3: 852-60(1961).

The Co^{60} gamma-ray induced degradation of butyl rubber and of its vulcanizates at 25° was investigated. Vinylidene groups are formed on irradiation in air and vacuum, causing the appearance of 11.25 μ bands in the IR spectra. The results may be regarded as further confirmation of the similarity in the mechanism of degradation of butyl rubber and polyisobutylene effected by ionizing radiation. The degradation rate of unfilled butyl rubber vulcanizates is greater than that of the filled specimens. Sulfur vulcanizates are less rapidly degraded than nonsulfur ones. The degradation of filled butyl rubber vulcanizates is accelerated by disulfides. The latter manifest greatest activity in the irradiation of sulfur vulcanizates. Oxygen accelerates only slightly the degradation of filled sulfur vulcanizates irradiated with Co^{60} gamma-rays. A regenerate with good plastoelastic and satisfactory physicomechanical properties may be obtained on exposure of butyl rubber sulfur vulcanizates to doses of $25 \cdot 10^6$ and $49 \cdot 10^6$ r in air in the presence of p-tert-butylphenol disulfide. (tr-auth)

25870 THE INTERPRETATION OF IRRADIATION CREEP EXPERIMENTS ON GRAPHITE SPRINGS. H. H. W. Losty (General Electric Co. Ltd., Wembley, Eng.). p.81-5 of "Institute of Metals Symposium on Uranium and Graphite," 1962. Communication No. 1010.

Irradiation creep experiments were made on graphite springs maintained at fixed deflections or carrying fixed loads. The interpretation of these experiments was considered and iterative methods were developed for the constant-

strain experiments which enable the data to be compared with the corresponding constant-stress experiments. The torsional creep coefficient is shown to be $\sim 6 \times 10^{-11}$/dyne/cm^2/1000 MWD/Ate and almost independent of the irradiation temperature. (auth)

25871 PRODUCTION OF GRAFT POLYMERS. Wilfrid Cooper and George Vaughan (To Dunlop Rubber Co. Ltd.). British Patent 901,736. July 25, 1962.

A process for producing graft polymers comprises subjecting an aqueous dispersion of a synthetic elastomer and a monomer to ionizing radiation of energy >0.1 Mev. The synthetic elastomer should be one forming lattices readily, and the dose rate should be 10^4 to 10^6 r/hr. Several examples of the process are given. (D.L.C.)

25872 IMPROVEMENTS IN OR RELATING TO OIL-EXTENDED POLYMERS. Douglas Bulgin (to Dunlop Rubber Co. Ltd.). British Patent 901,737. July 25, 1962.

A method is outlined for imparting improved resilience properties to oil-extended rubbers. The method comprises subjecting the dispersion of oil in elastomer to ionizing radiation of energy >0.1 Mev for a dose of 2 to 5×10^7 rad. The extending oil is of the hydrocarbon and preferably makes up to 20 to 40% of the weight of the elastomer, while the elastomer may be natural or synthetic rubber. (D.L.C.)

PHYSICS

General and Miscellaneous

25873 (AFOSR-1732) MULTIPLE EXCITATION AND IONIZATION OF INNER ATOMIC SHELLS BY X RAYS. Research Report No. 9. Herbert W. Schnopper (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Dec. 15, 1961. Contract AF 49(638)-402. 11p.

Re-investigation of the argon K absorption edge region has revealed a new resonance absorption structure followed by a new continuum. These new features may be interpreted as arising from double-electron-excitation processes in which an M electron, as well as the K electron, takes part in the transitions. The first new resonance line lies about 23 ev above the first line in the previously-observed single-electron-excitation resonance structure. No additional resonance structure was found in the region from zero to about 50 ev. The results are interesting since the physical system dealt with is a simple theoretical case, a monatomic, non-interacting atom. No significant theoretical predictions of multiple excitation or ionization of inner shells were made. (auth)

25874 (AFOSR-2714) SOME ASPECTS OF MAGNETOHYDRODYNAMIC FLOW ABOUT A BLUNT BODY. B. P. Leonard (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). June 1962. Contract AF 49 (638)-544. 61p.

Electromagnetic body forces are studied for the case of inviscid incompressible flow about a blunt body. The nonlinear simultaneous partial differential equations describing the flow can be solved in various regimes corresponding to certain values of two parameters: $Rm = \mu\sigma U_\infty \alpha$, the magnetic Reynolds number, and $\alpha^2 = (B_0^2/\mu)/(\rho U_\infty^2)$ where $1/\alpha$ is the Alfven number. For the case of small Rm, and small magnetic force coefficient, S (= α^2 Rm), equations can be derived which are linear and independent. These are solved for some particular unsteady flows, and the results show that vorticity is independent of time. The equations are linearized by using the velocity field of ordinary hydrodynamics (OHD) in the convective derivatives. This technique is valid for all Rm provided either α^2 or S is small. For large Rm it results in a solution showing a boundary-layer character. Two results are of interest: the appearance of the downstream nondiffusive trail of vorticity in the small Rm, small S case; and the region of significant current density is close to the body, and any wake-like effect is either highly diffusive (small Rm) or extremely weak (large Rm). (auth)

25875 (AFSWC-TDR-62-21) THE CALCULATION OF THERMODYNAMIC PROPERTIES OF GASES AT HIGH TEMPERATURES. Harold W. Woolley (National Bureau of Standards, Washington, D. C.). Mar. 1962. Contract AF 29(601)-60-4491. 188p.

The calculation of thermodynamic properties of gases at high temperature using ion solution theory is analyzed in regard to various details. Earlier work based on rigid sphere ions is discussed briefly. An extension to a more general case of realistic pair interactions is also obtained. With Debye screened ionic interactions, a study is made of effects of repulsions and both continuum and bound states for ionic attractions; simple approximate representations of the interaction effects for the two free particle interaction cases are given. For the bound states, the finite number of states available for occupancy as a result of Debye screening is explicitly indicated, and a numerical method to adjust from an arbitrary state sum to the Debye screened sum is explained. An extensive compensation between bound states just below the continuum and a partial state paucity within the continuum are also noted. Other details considered include the estimation of the dielectric constant up into the region of high density and high temperature, the semi-empirical estimation of nonbonding pair interactions involving neutral and ionized species, and corresponding virial-type exclusion effects. A table of second virials for constituents of air up to 20,000°K is included. An appendix is included describing the effects of intermolecular interactions on thermodynamic properties of gases at high temperatures and pressures. (auth)

25876 (AFSWP-844) THERMAL RADIATION STUDIES. Progress Report No. 9, July–December 1954. T. I. Monahan, L. Banet, W. L. Derksen, and R. C. Maggio (Naval Material Lab., Brooklyn). Mar. 10, 1955. 41p. (AD-270951)

Thermal radiation studies included development of laboratory sources of intense thermal radiation; laboratory evaluations of materials; effect of source and material parameters on thermal damage to materials; and protective measures. A W radiation source is discussed. The unit source was a 1000w, 120v W projection lamp with a color temperature of 3100°K. The material target was irradiated at the focus of a 36-in.-diam., 9-in. focal length paraboloidal reflector. Laboratory evaluations were made on the following: aircraft paint-on-metal systems, construction materials, liquid fuels, flight clothing, coatings, textiles, plastics, ceramics, asphalt, and skin simulant. The advantages and disadvantages of using lampblack-filled polyethylene for a skin simulant are discussed along with testing conditions. Hazards of skin burns caused by conducted heat were not reduced by treating clothing with flame retardants. (auth)

25877 (ANL-6534) PHYSICS DIVISION SUMMARY REPORT, APRIL–MAY 1962. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 62p.

The resolution width of boron-containing and lithium-containing glass scintillators used for neutron detection was made significantly narrower by improving the optical system used. The poor resolution obtained earlier was due to the nonuniformity of the photocathode of the photomultiplier and to the fraction of light actually extracted from the scintillator. Preliminary measurements of the total cross section of molybdenum for neutrons with energies from 10 to 1000 ev were completed. The effect of magnetic field on the frequency of electromagnetic radiation was studied. It was found that for fields of the order of a few thousand oersteds over distances of a few centimeters the frequency of the radiation was shifted by less than about four parts in 10^{15}. The (d,t) reaction on the five stable isotopes of titanium was studied at a deuteron energy of 21.4 Mev. Groups corresponding to the pickup of 2p neutrons were observed in both Ti^{50} and Ti^{48}. In the reaction of Ti^{48}, an $l = 2$ transition to a state near 1.8 Mev in Ti^{47} was found. The odd-even isotopes showed a number of strong groups. The ground-state transitions in $Ti^{48}(d,t)Ti^{47}$ and $Ti^{47}(d,t)Ti^{46}$ were not observed. Diffuse-surface optical-model calculations were carried out to obtain more realistic estimates of the single-particle width than were obtained from the R-matrix formalism. The results were compared with a $d_{\frac{3}{2}}$ resonance observed experimentally in the scattering

of protons from carbon. The background due to neutron scattering from the tantalum backing for lithium targets was measured for neutron energies from 2 to 300 kev for neutrons emitted at an angle of 120° with respect to the direction of the proton beam. The fraction was found to be large at low energies but fell steeply with increasing neutron energy to about 6.5% at 10 kev. It subsequently decreased gradually to about 2.8% at 100 kev, where it began to rise again and reached a maximum of about 6.3% near 250 kev. Classical reaction-rate theory and a criterion set forth by Rosenstock for the fragmentation of hydrocarbons were compared with experimental findings for three molecules: benzene, acetylene, and ethylene. The agreement appears to be satisfactory. The high-energy total cross sections for KN and NN scattering were interpreted in terms of the hypothesis of Regge poles (in the crossed channel) and generalized isospin independence. It is suggested that F_{1n}, the charge form factor of the neutron, is negative at low transferred momentum, and that the charge distribution of the proton is such that the bare proton is surrounded not only by a positively charged layer but also by a negatively charged layer because of the strong vacuum polarization due to the three-pion resonance ω. (auth)

25878 (ARL-62-319) RESEARCH IN PURIFICATION OF CADMIUM SULFIDE CRYSTALS AND OTHER II-IV COMPOUNDS. K. E. Bean, W. E. Medcalf, R. H. Fahrig, J. E. Powderly, and J. S. Roderique (Eagle-Picher Co., Miami, Okla.). Mar. 1962. 86p.

Selected elements from Groups II and VI were purified and synthesized to form high-purity compounds as follows: cadmium sulfide, zinc sulfide, cadmium telluride, cadmium oxide, and cadmium selenide. The growth of crystals from these compounds by both the melt and vapor phase methods is discussed. Evaluation of the electrical and optical properties of these materials are presented. (auth)

25879 (ARL-62-320) RADIATION LAWS UNDER NON-EQUILIBRIUM CONDITIONS. Ludwig Oster (Yale Univ., New Haven. Observatory). Apr. 1962. Contract AF 33 (657)-7271. 18p.

The familiar radiation laws are reviewed, showing that the phenomenological coefficients of emission, absorption, and conductivity are merely variants of the same basic quantity and can be readily transformed into each other. It follows that for a specific emission or absorption mechanism the calculation of either one of the coefficients is sufficient. The atomistic coefficients of spontaneous emission, absorption, and induced emission and their mutual relations are then derived from Einstein's quantum probabilities for the case of radiative transitions of free particles. The concepts of thermodynamic equilibrium, steady state and detailed balancing are recalled. The energy transfer equation and its solution are discussed. In high temperature plasmas the atomistic radiation mechanisms of bremsstrahlung and cyclotron radiation are the most prominent ones. Cross sections are given for both processes, including quantum effects. Finally, emission and absorption coefficients are derived for arbitrary non-equilibrium plasmas. (auth)

25880 (ARL-62-328) HIGH-TEMPERATURE TRANSPORT COEFFICIENTS OF SELECTED GASES. Boris Ragent and Charles E. Noble, Jr. (Vidya, Inc., Palo Alto, Calif.). Apr. 1962. Contract AF33(616)-8338. 119p.

High-temperature transport coefficients of air, air constituents, and the rare gases are reviewed. The theoretical framework used for computing transport coefficients is described and its limitations are indicated. The sources, both experimental and computed, of the interparticle potentials used in the calculations are presented. Data are shown in graphical form suitable for intercomparison, and criticisms of the data are made. Conclusions about the status of knowledge of transport coefficients are given, and recommendations are made for preferred values of transport coefficients in the temperature range higher than 4000°R. (auth)

25881 (ASD-TN-61-160) STATE-OF-THE-ART SURVEY OF SUPERCONDUCTIVITY AND SUPERCONDUCTING ELECTROMAGNETS. Robert A. Wolf (Aeronautical Systems Div. Physics Lab., Wright-Patterson AFB, Ohio). Nov. 15, 1961. 19p.

Some of the important characteristics and applications of superconducting materials were compiled from a survey of existing information on the subject of superconductivity. The basic properties of superconductors are described and a brief account of the Bardeen-Cooper-Shrieffer theory is given. The previously published data on the superconducting compound Nb_3Sn is reviewed, and superconducting solenoids utilizing this material are discussed. (auth)

25882 (ASD-TR-61-630) RESEARCH ON SPONTANEOUS MAGNETIZATION IN SOLID BODIES. I. S. Jacobs, D. S. Rodbell, and W. L. Roth (General Electric Co. Research Lab., Schenectady, N. Y.). Feb. 1962. Contract AF33(616)-7396. 45p.

A number of research projects dealing with fundamental interactions and the microstructure of internal fields in selected magnetic materials were carried out. The nuclear magnetic resonance of Co^{59} in metallic cobalt powders was examined. In addition to the absorption characteristic of Co^{59} in face-centered cubic cobalt, there was found an additional group of absorptions, one of which is clearly associated with hexagonal close packed cobalt. The phenomenon of spin-flopping in antiferromagnetic MnF_2, in which the axis of antiferromagnetism is decoupled from the crystal axes, was observed by magnetization measurements in high pulsed magnetic fields. Its position coincided with the value, 93 kOe, predicted from measurements of antiferromagnetic resonance with millimeter microwaves. The temperature dependence of the magnetocrystalline anisotropy of face-centered cubic cobalt metal was examined by ferromagnetic resonance on single crystal thin films and submicron precipitate particles in Cu, at temperatures below the range in which this is the stable structure. Satisfactory agreement is obtained for a tenth power law between anisotropy and magnetization. A very brief review on pulsed field magnetization measurements in compounds was prepared. An investigation of magnetic exchange and structure in lanthanum manganite perovskite compounds spanning the transition between antiferromagnetism and ferromagnetism was performed using neutron diffraction and high field magnetization techniques. Evidence favored the single-phase canted spin model for this region over the model of a mixture of two crystallographically similar but magnetically distinct phases. Seven additional exploratory projects were undertaken, some of which hold considerable promise for development. (auth)

25883 (CTSL-33) REFINEMENTS IN BUBBLE DENSITY MEASUREMENT. L. J. Fretwell, Jr., D. G. Coyne, and J. H. Mullins (California Inst. of Tech., Pasadena. Synchrotron Lab.). May 24, 1962. Contract AT(11-1)-68. 39p.

Two methods of satisfying the criteria for an estimator of bubble density were investigated: the gap length distribution method and the mean gap length method. The methods of analysis are described and procedures outlined. (M.C.G.)

25884 (D1-82-0171) INFLUENCE OF THE CRYSTAL FIELD ON THE ION-CORE STATES OF LITHIUM, SODIUM, AND POTASSIUM. Joachim C. Erdmann (Boeing Scientific Research Labs., Seattle). May 1962. 26p.

The tight-binding method for the calculation of one-electron states in solids was applied to the s-states of the outermost ion-core electrons of lithium, sodium, and potassium. Wave functions and electronic crystal potential are obtained from orthogonalized Slater orbitals. The 1s ion-core energy of solid lithium with equilibrium lattice parameter was found to be different from the value in the free atom by 0.100 Ry. The corresponding differences for the 2s state of sodium and the 3s state of potassium are 0.026 Ry and 0.0001 Ry, respectively. Reduction of the lattice constant leads to a significant shift of the 1s ion-core level in lithium, not, however, of the 2s state in sodium and the 3s state in potassium. These results appear to be consistent with some known observations of the soft x-ray emission of the metals. (auth)

25885 (GEST-2002) DIFFUSION OF CHARGED PARTICLES IN A PARABOLIC POTENTIAL WELL. E. Blue and J. A. Young (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). Mar. 19, 1962. For General Electric Co. Atomic Products Div., Palo Alto, Calif. 15p. (R62APE10)

The problem of the migration of charged particles in a parabolic electric potential well is solved in the diffusion approximation. The solution yields the source strength, density, and particle current density for electrons, ions, and neutrals as a function of the potential curvature and net electrical current. The results obtained from this formulation will be useful as a guide for a more complete treatment in which ionization and recombination cross sections are employed and in which the form of the potential is not assumed. These results will also be of use for analyzing potential distributions obtained in thermionic converters by means of probe measurements. (auth)

25886 (LNF-62/37) RACCOLTA DELLE COMUNICAZIONI DEL CONGRESSINO 1962 SULLA FISICA E LA RICERCA DI ALTA ENERGIA, FRASCATI, 7-8-9 FEBBRAIO 1962. (Compilation of the Reports to the 1962 Congress on High Energy Physics and Research, Frascati, February 7, 8 and 9, 1962). (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). May 1962. 255p. (In English and Italian)

Thirty-three papers are included. Topics discussed are experiments with the Frascati electron synchrotron and with the CERN accelerator. Individual abstracts have been prepared for 21 of the more significant papers. (J.S.R.)

25887 (LNF-62/37(p.7-9)) INTERESSE DELLE REAZIONI DI FOTOPRODUZIONE DOPPIA. (Interest in Double Photoproduction Reactions). D. Boccaletti and F. Selleri (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The double photoproduction reaction $\gamma + p \rightarrow p + \pi^+ + \pi^-$ has been studied experimentally but up to the present no satisfactory theoretical interpretation has been given. A brief review is made of the peripheral model interpretation. (J.S.R.)

25888 (LNF-62/37(p.10-13)) FOTODISINTEGRAZIONE E FOTOPRODUZIONE DI MESONI π IN He_2^4 DA FOTONI CON E_γ^{max} = 1000 Mev. (Photodisintegration and Photoproduction of π Mesons in He^4 from Photons with E_{max} Equal 1,000 Mev). P. E. Argan, G. Bendiscioli, V. Bisi, I. Ferrero, A. Gigli, A. Piazzoli, and G. Piragino (Italy. Istituto Nazionale di Fisica Nucleare, Genoa).

The photoproduction and decay reactions possible at γ energies up to 1,000 Mev in a He^4 diffusion chamber are studied. Possible reaction products are tabulated, and the angular distributions for such reaction products were studied. The anisotropy in the distribution is discussed and it is shown that the production of π in He has an anisotropy in the production plane of the reaction product. (J.S.R.)

25889 (LNF-62/37(p.13-23)) CONSERVAZIONE DELLA PARITA' NELLA FOTOPRODUZIONE DOPPIA DI PIONI AD ALTA ENERGIA. (Conservation of Parity in the Double Photoproduction of Pions at High Energy). A. Forino, E. Fuschini, C. Maroni, and P. Veronesi (Italy. Istituto Nazionale di Fisica Nucleare, Bologna).

An experiment designed to test conservation of parity using the double photoproduction reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$ is described. The presence in the distribution functions of pseudoscalar terms are investigated as a test of parity conservation. The experimental set-up and a block diagram of the electronic devices are shown graphically. Possible experimental results and their theoretical significance are discussed. (J.S.R.)

25890 (LNF-62/37(p.28-34)) MISURA FINE DELLA SEZIONE D'URTO NEL PROCESSO $\gamma + p \rightarrow \pi^0 + p$ INTORNO ALLA II RISONANZA. (Refined Measurement of the Cross Section of the Process $\gamma + p \rightarrow \pi^0 + p$ Around the First Resonance). M. Deutsch, C. Mencuccini, R. Querzoli, G. Salvini, V. Silvestrini, and R. Stiening (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The differential cross section of the process of $\gamma + p \rightarrow \pi^0 + p$ was measured with improved precision. The experimental apparatus and the processing of the data are described. The experimental results are shown graphically and compared with results obtained previously. (J.S.R.)

25891 (LNF-62/37(p.34-9)) RISULTATI OTTENUTI E PROSPETTIVE DI LAVORO NELLA FOTOPRODUZIONE DI π^+ INTORNO ALLA SECONDA RISONANZA. (Present and Prospective Results of Work on the Photoproduction of π^+ Around the Second Resonance). M. Beneventano, R. Finzi, L. Mezzetti, L. Paoluzi, and S. Tazzari (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The differential cross section for the reaction of $\gamma + p \rightarrow n + \pi^+$ was measured at 600, 700, and 800 Mev for pion angles between 10 and 0°, and the differential cross section at 0° was measured directly for photon energies between 550 and 950 Mev. The results obtained are shown graphically. The significance of the experimental data is discussed. (J.S.R.)

25892 (LNF-62/37(p.46-56)) FOTOPRODUZIONE IN AVANTI DI π^0 IN INDROGENO. (Forward Photoproduction of π^0 in Hydrogen). E. H. Bellamy (Westfield Coll., London), G. Bellettini, C. Bemporad (Italy. Istituto Nazionale di Fisica Nucleare, Pisa), and L. Foà (Italy. Istituto Nazionale di Fisica Nucleare, Florence).

A study is being made to measure the differential cross section for the photoproduction of π^0 in H_2 in the angular region between 25 and 60° in the center-of-mass system and for incident γ energies above 500 Mev. The experimental apparatus is described in detail with an in-depth consideration of the calibration and operating characteristics. (J.S.R.)

25893 (LNF-62/37(p.57-71)) MISURA DELLA FOTOPRODUZIONE COULOMBIANA DI π^0 SU NUCLEO (EFFETTO PRIMAKOFF). (Measurement of the Coulomb Photoproduction of π^0 on Nuclei (Primakoff Effect)). G. Bellettini, C. Bemporad (Italy. Istituto Nazionale di Fisica Nucleare, Pisa) and L. Foà (Italy. Istituto Nazionale di Fisica Nucleare, Florence).

The theoretical bases and the experimental apparatus for the measurement of the Primakoff effect in the Coulomb photoproduction of π^0 on nuclei are discussed in detail. Block diagrams of the experimental apparatus and electronic circuits and the calibration curves are given. (J.S.R.)

25894 (LNF-62/37(p.72-5)) MISURE IN PREPARAZIONE DELLA SEZIONE D'URTO DI PRODUZIONE DI K^+ NELLA REAZIONE $\gamma + p = K^+ + \Lambda^0$. (Preparation for the Measurement of the Production Cross Section of K^+ in the Reaction $\gamma + p = K^+ + \Lambda^0$). B. Borgia, M. Grilli, P. Joos, L. Mezzetti, M. Nigro, F. Schiavuta, and F. Villa (Italy. Istituto Nazionale di Fisica Nucleare, Padua and Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The present state of preparation for measurements on the reactions $\gamma + p = K^+ + \Lambda^0$ and $\gamma + p = K^+ + \Sigma^0$ is reviewed. The geometrical arrangement of the counters, including those for the measurement of the polarization of Λ^0, is shown schematically. The theoretical bases for the measurements are discussed. (J.S.R.)

25895 (LNF-62/37(p.76-80)) PROGETTO DI MISURA DELLA POLARIZZAZIONE DELLA Λ^0 NELLA REAZIONE $\gamma + p \rightarrow K^+ + \Lambda^0$. (Plan for the Measurement of the Polarization of Λ^0 in the Reaction $\gamma + p \rightarrow K^+ + \Lambda^0$). B. Borgia, M. Grilli, P. Joos, L. Mezzetti, M. Nigro, E. Schiavuta, and F. Villa (Italy. Istituto Nazionale di Fisica Nucleare, Padua and Italy. Istituto Nazionale di Fisica Nucleare, Rome).

In the reaction $\gamma + p \rightarrow K^+ + \Lambda^0$, the Λ^0 may be polarized perpendicular to the production plane. This polarization cannot be measured directly, but must be determined through the asymmetry of the decay $\Lambda^0 \rightarrow p + \pi^-$. The arguments used in the design of the experimental setup are briefly reviewed, and the precautions taken to reduce possible systematic errors are discussed. (J.S.R.)

25896 (LNF-62/37(p.81-8)) SUI FATTORI DI FORMA ELETTROMAGNETICI DEI MESONI E DEI BARIONI. (Electromagnetic Form Factors of Mesons and Baryons). N. Dallaporta and V. De Santis (Italy. Istituto Nazionale di Fisica Nucleare, Padua).

A nucleon model purposed by Bergeia et al. (Phys. Rev. Letters, 6: 367(1961)) was extended to all particles possessing strong interactions using the following assumptions: invariance for four-dimensional rotations in the isobaric space of K interactions, only one two-pion resonant state and one three-pion resonant state as intermediate states between the current and the photons, and only G invariant couplings are admitted between the current and the multipion states. (J.S.R.)

25897 (LNF-62/37(p.89-98)) RICERCA DEL PROCESSO $\gamma + p \rightarrow \eta + p$ ($\eta \rightarrow \pi^0 + \gamma$). (Study on the Process $\gamma + p \rightarrow \eta + p$ ($\eta \rightarrow \pi^0 + \gamma$). C. Mencuccini, R. Querzoli, G. Salvini, and V. Silvestrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The present experimental situation in the study of strong interactions is briefly reviewed. A new method for the study of the photoproduction of particles, excitation curves, is briefly described. The advantages and disadvantages of the excitation curve method are discussed. An adaptation of this method—controlled excitation curve—consists of formulating reasonable hypotheses on the decay mode of the particle sought and arranging one or more counters to select this type of event from all other events in coincidence. The experimental setup for this method is shown graphically and discussed. (J.S.R.)

25898 (LNF-62/37(p.98-104)) FOTOPRODUZIONE DI MESONI NEUTRI DI MASSA COMPRESA TRA 300 E 800 Mev. (Photoproduction of Neutral Mesons with Mass Between 300 and 800 Mev). A. Cacciani, G. Cortellessa, A. Reale, and P. Salvadori (Italy. Istituto Superiore di Sanita, Rome).

Recently experimentations on multiple meson events have introduced a series of completely new neutral and charged mesons. A study is being made to show the existence of the photoproduction of a particle of mass 310 Mev which decays into two charged π mesons accompanied part of the time by a γ ray. The experimental methods to be used for this study are discussed. Complementary studies on the photoproduction of a particle with a mass of 800 Mev which decays into two or three π mesons are also being planned. (J.S.R.)

25899 (LNF-62/37(p.105-9)) FOTOPRODUZIONE DI COPPIE DI MESONI μ IN CARBONIO. (Photoproduction of μ Meson Pairs in Carbon). A. Alberigi, M. De Pretis, G. Marini, A. Odian, G. Stoppini, and L. Tau (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A series of measurements on the photoproduction of μ-meson pairs was completed, and the results of an analysis of the measurements are given. The experimental apparatus is shown schematically and its functioning is discussed. The results of a preliminary analysis are tabulated, and the experimental and theoretical cross sections are compared. (J.S.R.)

25900 (LNF-62/37(p.115-17)) ESPERIMENTI ESEGUITI E IN PROGETTO A NAPOLI SULLA FOTOFISSIONE E SULLA FOTODISINTEGRAZIONE NUCLEARE. (Experiments Performed and in Progress at Naples on Photofission and Nuclear Photodisintegration). (Italy. Istituto Nazionale di Fisica Nucleare, Naples).

The results of work completed are summarized. The areas being studied at present are spallation produced by photons of preselected energies and the β decay chain following fission. (J.S.R.)

25901 (LNF-62/37(p.118-38)) MISURE DI VITA MEDIA DI MESONI π SU TRAIETTORIA RETTILINEA E CIRCOLARE. (Measurement of the Mean Life of π Mesons on Rectilinear and Circular Trajectories). M. Ageno, G. Matthiae (Italy. Istituto Superiore di Sanità, Rome), E. Amaldi (Rome. Universita. Istituto di Fisica), B. Rispoli (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia), and G. Sanna (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The problems to be solved in the measurement of the mean life of π mesons are reviewed in some detail as an introduction to the discussion of the principles of the experimental apparatus. The effective conditions for the measurements were derived and corrections that must be made because of impurities in the pion beam are given. The present state of the experiment is tabulated. (J.S.R.)

25902 (LNF-62/37(p.138-42)) CATTURA DI MESONI π^- IN NUCLEI COMPLESSI. (Capture of π^- Mesons in Complex Nuclei). G. Campos Venuti and G. Matthiae (Italy. Istituto Superiore di Sanità, Rome).

A study to determine the neutron spectrum emitted from nuclei as a result of the absorption of π^- mesons is described. The time-of-flight method is to be used for the detection and measurement of the neutrons. The corrections which must be made with the experimental apparatus used are described. (J.S.R.)

25903 (LNF-62/37(p.142-56)) PROGRAMMA DI RICERCA CON LA "LUCE" DEL SINCROTRONE DI FRASCATI. (Research Program with the "Light" of the Frascati Synchrotron). M. Ageno and G. Missoni (Italy. Istituto Superiore di Sanita, Rome).

The research program at Frascati on the synchrotron beam—beam extraction and a determination of its geometric, energetic, and polarization characteristics—is briefly reviewed. The theoretical calculations on the beam properties are discussed and beam extraction is reviewed. The methods used to determine and regulate the beam properties are then described. (J.S.R.)

25904 (LNF-62/37(p.157-8)) PROGRAMMES FOR THE PISA COMPUTER TO ANALYZE MEASUREMENTS OF BUBBLE CHAMBER PHOTOGRAPHS. (Pisa, Italy. Universita. Istituto di Fisica).

Programs are being prepared for the Pisa computer to carry out calculations necessary for the geometric reconstruction and kinematic analysis associated with bubble chamber experiments. The characteristics of these programs are briefly reviewed. (J.S.R.)

25905 (LNF-62/37(p.161-5)) UNA PROPOSTA PER LA REALIZZAZIONE DI ANELLI DI ACCUMULAZIONE PER ELETTRONI E POSITRONI. (A Proposal for the Construction of Storage Rings for Electrons and Positrons). F. Amman, M. Bassetti, M. Bernardini, et al. (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A brief review is given of the work being done on the construction of storage rings for electrons and positrons. The theoretical problems being studied are tabulated, and the engineering problems to be solved are indicated. The reasons for the decision to construct a 750- and a 1500-Mev storage ring are briefly summarized. (J.S.R.)

25906 (LNF-62/37(p.166-79)) STUDIO PRELIMINARE SULLA POSSIBILITA' DI MISURARE LA REAZIONE $e^+ + e^- = K^+ + K^-$ CON UNA MACCHINA TIPO "ADONE." (Preliminary Studies on the Possibility of Measuring the Reaction $e^+ + e^- = K^+ + K^-$ with a Machine of the Adone Type). M. Grilli and S. Tazzari (Italy. Istituto Nazionale di Fisica Nucleare, Padua and Italy. Istituto Nazionale di Fisica Nuclear, Rome).

The characteristics and difficulties of experimentation with a machine of the ADONE type are described. As an example, one scheme for the selection, from the various two-body reactions, of $K^+ + K^-$ reactions is described. The method used in the measurement of this reaction with a range telescope and the results obtained are discussed in detail. (J.S.R.)

25907 (LNF-62/37(p.180-3)) SULLE POSSIBILITA' DI IMPIEGO DELLE EMULSIONI NUCLEARI IN ESPERIENZE CON ADONE. (The Possibility of Using Nuclear Emulsions with Experiments with Adone). (Italy. Istituto Nazionale di Fisica Nucleare, Turin).

The possibility of using nuclear emulsions in experiments with ADONE is discussed with respect to the detectability of events, the economy of the results, the background, and competition with other techniques. (J.S.R.)

25908 (NAA-SR-Memo-7278) THE POWER OUTPUT AND EFFICIENCY OF THERMIONIC CONVERTERS CONNECTED IN SERIES AND PARALLEL CIRCUITS—PART I. J. W. Holland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 10, 1962. Contract [AT(11-1)-Gen-8]. 37p.

Optimum and off-optimum performance is experimentally obtained for one of the 10 mil spaced, 7 cm^2 emitter area, cylindrical geometry thermionic converters to be used in the series and parallel connected thermionic converter experiment. The results are presented as graphs of output voltage vs power input, and power output vs power input. The current is the major parameter in both cases. The data in these forms are used to compute the power output of twin converter circuits having unequal power inputs. The optimum load conditions for operation are then determined. The results are valuable in guiding thermionic power plant design. (auth)

25909 (NEVIS-105) Mu MESONIC ATOM STUDIES OF Ti, Fe, Cu, Zn, Tl, Pb, Bi. W. Frati and J. Rainwater (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). [1961]. Contract Nonr-166(72). 59p. (R-323; CU-212)

The results of a precision re-evaluation of the mu-mesonic x-ray transition energies for Tl, Pb, Bi, Ti, Fe, Cu, and Zn are presented. The 2p-1s and 3d-2p transition regions were studied for Tl, Pb, and Bi, and the 2p fine structure splitting was determined with good precision from both sets of measurements. Tl, Pb, and Bi transition energies were determined to about 0.2%, while the 2p state fine structure splitting was determined to within 2 to 3%. The results are in good agreement with theoretically predicted values of others based on the charge distributions implied from the high energy electron scattering experiments. An anomaly in the observed intensity ratio of the $2p_{3/2}$-1s to $2p_{1/2}$-1s transitions for Bi and Tl is discussed. It is believed to be due to an excitation of the first excited state of the initial nucleus. The observed 2p-1s transition energies for Ti, Fe, Cu, and Zn are also given. The experimental uncertainties were 0.2 to 0.3%, and comparison with theoretically predicted values is much improved relative to earlier experimental results. (auth)

25910 (NP-11749) ANNUAL PROGRESS REPORT [ON PHYSICS] FOR YEAR 1961. Final Report. G. M. Temmer (Florida State Univ., Tallahassee. Yandem Accelerator Lab.). 125p.

Operation of the tandem accelerators is described and details of the experimental program are given including results on various particle reactions and interactions. Details of several nuclear physics theoretical studies are also presented. In instrumentation, efforts were devoted to an electrochemical system for measurement of residual radioactivity, the scattering chamber, magnetic analyzing system for reaction products, and acceleration of alpha particles in the tandem Van de Graaff generator. A list of publications during the period is included. (J.R.D.)

25911 (NP-11813) HYDRODYNAMICS OF HELIUM II. C. C. Lin (Massachusetts Inst. of Tech., Cambridge). [1961]. 109p.

Information is presented on hydrodynamics of ordinary fluids which are related to superfluid He. Included are chapters on hydrodynamics of ordinary fluids in relation to reversible and irreversible processes, and on the hydrodynamics of superfluids in relation to these processes. Also included are chapters on hydrodynamics of liquid He II and on experimental results on irrotational flow. (J.R.D.)

25912 (NP-11848) DEVIATION OF MAST OPERATION FROM ONE-DIMENSIONAL MODEL. Research Report 126. F. J. Fishman and H. E. Petschek (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Apr. 1962. Contracts AF 49(638)-61 and AF 49(638)-1129. 20p.

In the magnetic annular shock tube (MAST), the gas is pushed axially along the annular space between concentric

cylinders by an azimuthal magnetic field. Since a vacuum azimuthal magnetic field varies inversely as the radius, there is a variation in the driving pressure across the annulus, which leads to radial non-uniformities in the flow. These are analyzed for small ratios (ϵ) of the annulus spacing to the radius. This pressure variation across the annulus at the interface between the plasma and the driving field results in a tilting of the interface. This tilting is shown to be completely analogous to the flow resulting from a dam break in shallow water theory is characterized by a wave of propagation speed $\sqrt{\epsilon p/\rho}$. The maximum value of ϵ for which the tilted current sheet does not catch up with the shock wave is calculated and it is suggested that only MASTS with ϵ's smaller than this value produce reasonably uniform flow regions. Non-uniformities are also produced at the shock front when an azimuthal magnetic field is present ahead of the shock. These lead to a non-planar shock front whose shape is calculated, and to non-uniform conditions in the plasma behind the shock. The non-uniformities which persist far behind the shock are computed; these results indicate that for low shock Mach numbers appreciable non-uniformities in pressure and temperature exist even for fairly small values of ϵ. (auth)

25913 (NP-11892) THE MAGNETOHYDRODYNAMIC FLOW PAST A NON-CONDUCTING FLAT PLATE IN THE PRESENCE OF A TRANSVERSE MAGNETIC FIELD (thesis). Technical Report 397. Donald M. Dix (Massachusetts Inst. of Tech., Cambridge). 1961. 134p.

The general character of the magnetohydrodynamic flow past a nonconducting flat plate in the presence of transverse magnetic fields is analyzed. The appropriate extension of the Rayleigh problem to the magnetohydrodynamic case is shown to yield solutions that correctly predict some features of the steady flow past a semi-infinite flat plate. Also, it is shown that the knowledge of these significant features permits an easy evaluation of their magnitudes in other extensions of the Rayleigh problem. The flow past a semi-infinite flat plate is analyzed by two methods. First, by linearizing the governing equations and incorporating the assumption of a low ratio of viscous-to-magnetic diffusivity, the results for skin friction and the normal component of magnetic field at the plate are obtained, and are shown to be useful in interpreting the character of these low conductivity flows. Second, the complete set of governing equations is formulated as a finite difference problem and solved numerically on a digital computer. The results obtained show that the disturbance produced by the plate is no longer confined to a thin viscous layer if the ratio of viscous-to-magnetic diffusivity is greater than 10^{-2}; but that an appreciable Alfvén type of disturbance is excited. (auth)

25914 (NP-11920) LUMINESCENCE OF ALKALI HALIDES UNDER IONIZING RADIATION. G. Bonissoni, P. Camagni, and G. Chiarotti (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). June 1962. 20p.

Luminescence spectra of KCl, KBr, and NaCl crystals were investigated using x rays or F light as the exciting agent. The spectra show well defined bands, characteristic of the various salts. However, the relative heights of the luminescence bands depend largely on thermal pretreatment. The intensity of the emission bands varies in time as a result of x irradiation; the kinetics and the restoration of these phenomena was studied in a range of temperatures from −180°C to room temperature. Some of the bands were present in uncolored crystals excited by x rays, as well as in colored crystals excited by F light; in these cases the emission was associated with the annihilation of trapped holes by electrons from the conduction band. (auth)

25915 (NP-11936) BIBLIOGRAPHY ON FUEL CELLS. Bibliographical Series No. 1. T. D. Wilson (Parsons (C. A.) and Co., Ltd., Newcastle-upon-Tyne, England). June 26, 1961. 33p.

References (232) are given to periodicals, theses, patents, and reports published from 1940 to 1961. The references are listed alphabetically according to author. (P.C.H.)

25916 (NP-11977) RACCOLTA DELLE COMUNICAZIONI DEL CONGRESSINO 1960 SULLA FISICA E LA RICERCA DI ALTA ENERGIA, FRASCATI, 16-17 DICEMBRE 1960. (Compilation of the Reports to the 1960 Congress on High Energy Physics and Research, Frascati, December 16-17, 1960). (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Mar. 1961. 186p. (In English and Italian)

Fifty-one papers are included. The topics discussed are programs relative to the design and construction of new accelerators and the research at available accelerators. Individual abstracts have been prepared for 33 of the more significant papers. (J.S.R.)

25917 (NP-11977(p.2-5)) A SURVEY OF ACCELERATOR RESEARCH AT CERN. H. G. Hereward (European Organization for Nuclear Research, Geneva).

The four principal lines of research being undertaken by the accelerator group at CERN are storage ring, r-f separator, spark chamber, and FFAG studies. Each of these are discussed individually, and the practical results obtained are reviewed. (J.S.R.)

25918 (NP-11977(p.5-20)) PRESENT IDEAS ON 25-Gev PROTON STORAGE RINGS. K. Johnson (European Organization for Nuclear Research, Geneva).

The theoretical work being done on the principle of stacking and the design of a small storage ring is described. The principle of the storage ring system is considered, and the design of such a system for the CERN proton synchrotron is described. The basic design is a proton synchrotron design to which necessary and desirable modifications to fit the specific storage ring requirements are made. The design factors considered are the magnet, magnet power supply, r-f system, beam handling system, buildings, cost, construction time, expected performance, and techniques and problems of experiments with colliding beams. The construction of the small storage ring for electrons at CERN is briefly described. (J.S.R.)

25919 (NP-11977(p.20-31)) SUR LA POSSIBILITE D'UN ACCELERATEUR DE PROTONS DE 15 GeV, DIZAINES DE MICRO-AMPERES A DEBIT QUASI-CONTINU OU DISCONTINU, UNE FOIS PAR SECONDE. (The Possibility of a 15-Bev Proton Accelerator, Tens of Microamperes with Quasi-continuous or Discontinuous Yield' Once Per Second). H. Bruck (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay).

The design of a 15 Bev accelerator with a mean current of 30 amp, equivalent to 2×10^{14} protons per sec, is considered. Such an accelerator would need an almost continuous utilization time for counter experiments or the utilization of all the particles once per sec for bubble chambers. The solution for these problems is discussed for a Linac injector, a rapidly pulsed synchrotron with alternating gradient, and a storage ring. An attempt is made to justify the order of magnitude of the orbit parameters of such a device. (J.S.R.)

25920 (NP-11977(p.40-4)) DECADIMENTO DEI MESONI K POSITIVI. IPERONI SIGMA CARICHI. (Decay of Positive K Mesons. Charged Sigma Hyperons). G. Quareni (Italy. Istituto Nazionale di Fisica Nucleare, Bologna).

Experiments being planned for the study of the decay of K^+ mesons and charged Σ hyperons are described. In the study of the decay of K^+ it is planned to make an accurate determination of the spectra of three-body decay and to determine possible new decay modes. An example of the data obtained for τ mesons is given. In the study of the charged Σ, the emphasis will be on lepton and photon decay. (J.S.R.)

25921 (NP-11977(p.45-48)) IONIZATION MEASUREMENTS ON FILM FROM THE CERN 30-CM HYDROGEN BUBBLE CHAMBER. C. Dilworth, G. Mambriani (Italy. Istituto Nazionale di Fisica Nucleare, Milan), and D. Morrison (European Organization for Nuclear Research, Geneva).

A study was made to find what significant information could be obtained on the velocity of a particle by measurement of a parameter related to the bubble density. Three possible parameters were studied—bubble count, gap count, and mean gap length. The most suitable parameter for determining ionization, and hence velocity, seems to be the mean gap length. No significant variation of mean gap length over the chamber was found. Under these conditions, it is possible to separate π mesons from protons up to momenta of at least 1.5 Bev/c. (J.S.R.)

25922 (NP-11977(p.49-52)) MISURA DELLA POLARIZZAZIONE DEI NEUTRONI DA CATTURA DI MESONI μ^-. (Measurement of the Polarization of Neutrons from the Capture of μ^- Mesons). M. Conversi, L. di Lella, A. Egidi, C. Rubbia, and M. Toller (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The experimental setup being designed for the measurement of neutron polarization by μ^- capture is described. It is planned to use a target of calcium for the μ^- beam at CERN. (J.S.R.)

25923 (NP-11977(p.53-4)) RICERCA DELLA CATTURA RADIATIVA DEL MESONE MU. (Research on the Radiative Capture of Mu Mesons). M. Conversi, L. di Lella, C. Rubbia, and M. Toller (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

An experimental method for the measurement of the radiative capture of muons is described. The method consists in the measurement of the gamma emitted by a copper target irradiated with a pure intense beam of muons. The gamma rays are measured with a NaI scintillator, preceded by a plastic scintillator in anticoincidence, by a lead converter, and by a plastic scintillator telescope in coincidence. The factors that can reduce the background to improve the measurement accuracy are briefly discussed. (J.S.R.)

25924 (NP-11977(p.55-7)) PROGRESS REPORT OF THE TRIESTE GROUP FROM JANUARY TO OCTOBER 1960. C. Cernigoi (Italy. Istituto Nazionale di Fisica Nucleare, Trieste).

The cross section at 0° for the charge-exchange scattering of negative pions at 170 Mev is being measured directly by detecting pairs of gamma rays from the π^0 decay. The gamma pairs are detected by two total-absorption Cherenkov counters and simultaneously by two gamma telescopes. The arrangement is shown schematically. The Cherenkov counters were calibrated by the electrons present in the 150-Mev π^- beam. (J.S.R.)

25925 (NP-11977(p.60-2)) IMPIEGO DELLA CAMERA A BOLLE AD ELIO. (Use of Helium Bubble Chamber). R. Bizzarri, E. Di Capua, U. Dore, G. C. Gialanella, P. Guidoni, and G. C. Moneti (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The He bubble chamber is being used for three experiments at the CERN proton synchrotron: study of the interactions of K^- mesons at rest, study of the annihilation of antiprotons at rest, and measurement of the polarization of recoil protons from π,p scattering at various angles and energies. The data obtainable from the analysis of these events in the He bubble chamber are described. (J.S.R.)

25926 (NP-11977(p.64-5)) PROPOSTA PER ESPERIMENTI CON $\bar{p}$ DA ESEGUIRSI AL CERN CON CAMERE A BOLLE. (Proposal for Experiments with $\bar{p}$ to be Performed at CERN with the Bubble Chamber). R. Bizzarri (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

Studies being planned for the interactions of antiprotons at rest using the Gregory bubble chamber are described. The methods to be used to overcome the various foreseeable difficulties are briefly reviewed. (J.S.R.)

25927 (NP-11977(p.66-7)) THE PRODUCTION OF PION PAIRS BY 14 Gev/c PIONS. F. Baldassare, A. Caforio, D. Ferrara et al. (Bari, Italy. Universita. Istituto di Fisica), J. C. Combe, W. M. Gibson, W. O. Lock (European Organization for Nuclear Research, Geneva), A. Bonetti, M. di Corato, A. Fedrighini et al. (Italy. Istituto Nazionale di Fisica Nucleare, Milan).

A stack of nuclear emulsion was exposed to a 14-Bev momentum-analyzed beam of the CERN proton synchrotron. A search was made for pion pairs produced by beam pions without appreciable excitation of the target nucleus. Four events were found in which an incoming particle produced a jet of three particles with the following characteristics: None of the secondaries is an electron, the total transverse momentum of the secondaries is not significantly greater than 140 Mev/c, the sum of the energies of the secondaries is not significantly different from 14 Bev, and there is no evidence of nuclear excitation at the apex of the event. The four examples found yield a mean free path of about 42 meters in nuclear emulsions. (J.S.R.)

25928 (NP-11977(p.71-7)) SOME PROBLEMS OF HIGH-ENERGY PHYSICS. R. Gatto (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The probable importance of studies of weak interactions in a research program with high-energy machines is illustrated. The theoretical consequences of the presence or absence of cut-offs are indicated. (J.S.R.)

25929 (NP-11977(p.78-80)) ELEMENTI DI PROGETTO DI UN ELETTROSINCROTRONE DA 10 GeV. (Elements of the Plan of a 10-Bev Electron Synchrotron). F. Amman, R. Cerchia, and M. Puglisi (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The characteristics of the magnet, power supply, and radio-frequency system of a proposed 10 Bev synchrotron are tabulated. (J.S.R.)

25930 (NP-11977(p.80-8)) ANELLO DI ACCUMULAZIONE PER ELETRONI E POSITRONI (ADONE). (Storage Ring for Electrons and Posjtrons (ADONE)). F. Amman, C. Bernardini, R. Gatto, G. Ghigo, and B. Touschek (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A brief summary is given of the physical and technical problems relative to a colliding beam accelerator having storage rings for electrons and positrons of 15-Mev each. The preliminary data for such rings and cost estimates are given. (J.S.R.)

25931 (NP-11977(p.90-2)) FOTOPRODUZIONE DI COPPIE DI MESONI μ SU NUCLEI. (Photoproduction of μ Meson Couples on Nuclei). A. Odian (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The experimental setup for the determination of the absolute cross section for the photoproduction of muon couples in the coulomb field of nuclei such as C and Al is described. The principal difficulties in such a measurement are the low cross section and the high background of electron pairs and muons from pion decay. Preliminary measurements have permitted an evaluation of this background. The schematic arrangement used for the preliminary measurements is shown and described. (J.S.R.)

25932 (NP-11977(p.93-4)) POSSIBILITA' DI OTTENERE UN FASCIO DI FOTONI POLARIZZATI DAL SINCROTRONE DI FRASCATI. (Possibility of Obtaining a Beam of Polarized Photons from the Frascati Synchrotron). G. Barbiellini, G. Bologna, G. Diambrini, and G. P. Murtas (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The use of a silicon crystal as a γ converter in order to obtain a beam of polarized photons from the Frascati synchrotron with sufficient intensity to study the photoproduction of mesons is discussed. The polarization obtainable with the crystal is quite uncertain. Preliminary results show a new fine structure in the variation of the photon intensity (at a given energy) as a function of the angle between the crystalline axis and the direction of primary electrons. (J.S.R.)

25933 (NP-11977(p.94-6)) FOTOPRODUZIONE DI π^0 DA γ POLARIZZATI. (Photoproduction of π^0 from Polarized γ). B. De Tollis and A. Verganelakis (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The effect of a possible pion-pion interaction in the resonant state T = 1, J = 1 on the photoproduction of π^0 by polarized γ was evaluated. Use was made of the unidimensional representation of the scattering matrix deduced by Cini and Fubini. (J.S.R.)

25934 (NP-11977(p.97-99)) PROPOSAL EXPERIMENT ON THE PRODUCTION OF π^0 MESONS BY POLARIZED PHOTONS. J. De Wire (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A study on the reaction $\gamma + p \rightarrow p + \pi^0$ in the energy region of the ($^3/_2$, $^3/_2$) resonance using the partially plane-polarized photon beam of the Frascati synchrotron is proposed. The cross section will be observed with a photon range telescope in coincidence with a photon shower counter to detect a π^0 decay photon. The ratio of the counting rate for the beam polarized perpendicularly to the reaction plane to the counting rate for the plane parallel to it will be observed. (J.S.R.)

25935 (NP-11977(p.99-100)) ALCUNE CONSIDERAZIONI SULLA FOTOPRODUZIONE DI π^+ CON UN FASCIO DI FOTONI POLARIZZATI. (Some Considerations on the Photoproduction of π^+ with a Beam of Polarized Photons). B. Borgia, M. Grilli, L. Mezzetti, and S. Tazzari (Italy. Istituto Nazionale di Fisica Nucleare, Padua and Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The characteristics of the photoproduction of π^+ for γ energies near 300 Mev, which can be studied with the use of a polarized beam of γ rays, are investigated. Emphasis is placed on the effect of the "small phase" (phases of the P wave in the T = $^1/_2$ state and of the S wave in the T = $^1/_2$ and T = $^3/_2$ states) on the cross section for photoproduction. (J.S.R.)

25936 (NP-11977(p.102-4)) FOTOPRODUZIONE DI MESONI π^0 IDROGENO. (Photoproduction of π^0 Mesons from H_2). C. Cortellessa, A. Reale, P. Salvadori (Italy. Istituto Superiore di Sanita, Rome), and K. Berkelman (Cornell Univ., Ithaca, N. Y.).

A range telescope in air and a lead window Cherenkov counter in coincidence were used to detect the recoil protons and the decay γ from the single photoproduction of π^0 mesons in H_2. Other devices to be used for the detection of protons of different energies are briefly described. (J.S.R.)

25937 (NP-11977(p.107-8)) MISURA DELLA PRODUZIONE IN AVANTI DI π^0 IN INDROGENO. (Measurement of the Production of π^0 in Hydrogen). G. Bellettini, C. Bemporad (Pisa, Italy. Universita. Istituto di Fisica), L. Foa' (Florence. Universita. Istituto di Fisica), and E. H. Bellamy (Westfield Coll., London).

A study is being made of the differential cross section for the production of π^0 in H_2 in the angular region of π^0 in the center of mass system from 20 to 60° and in the γ energy interval from 600 to 1000 Mev. The energy of the recoil proton from 20 to 160 Mev will be measured simultaneously with a scintillation telescope. (J.S.R.)

25938 (NP-11977(p.109-10)) MISURA DELLA FOTOPRODUZIONE DI π^0 IN UN CAMPO COULOMBIANO (EFFETTO PRIMAKOFF). (Measurement of the Photoproduction of π^0 in a Coulomb Field (Primakoff Effect)). G. Bellettini, C. Bemporad (Pisa, Italy. Universita. Istituto di Fisica), L. Foa' (Florence, Universita. Istituto di Fisica), and E. H. Bellamy (Westfield Coll., London).

A measurement of the differential cross section for the photoproduction of π^0 in a Coulomb field in the angular region between 0 and 2° and for an incident γ energy of 1,000 Mev will permit a determination of the mean life of π^0. Such a measurement would be based on the detection of the two decay gamma rays of the π^0 and on the simultaneous measurement. The experimental setup for this measurement is shown schematically. The target nuclei would be of high Z in order to have a high Coulomb production and of zero spin in order to have no coherent nuclear production. (J.S.R.)

25939 (NP-11977(p.111-15)) MISURA DELLA POLARIZZAZIONE DEI PROTONI DI RINCULO NELLA FOTOPRODUZIONE SINGOLA. (Measurement of the Polarization of Recoil Protons in Single Photoproduction). M. Deutch, C. Mencuccini, R. Querzoli, G. Salvini, and G. V. Silvestrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

From the hypothesis that only the three resonant states contribute to the photoproduction $\gamma + p \rightarrow \pi^0 + p$ in the energy region up to 1,000 Mev, a provisional assignment of the transitions which determine the I, II, and III resonances in single photoproduction can be made. These provisional assignments are tabulated. In the present study an attempt is made to confirm these assignments with particular reference to the three resonances and to describe simple photoproduction under the assumption of only three levels. The experimental apparatus is described in some detail. The problems in the measurement of the absolute cross section for the photoproduction of π^0 are discussed. (J.S.R.)

25940 (NP-11977(p.116-20)) ATTUALE SITUAZIONE E PROGRAMMI SULLE CAMERE A SCINTILLE. (Actual Situation and Programs on Scintillation Chambers). M. Deutch, C. Mencuccini, R. Querzoli, G. Salvini, and G. V. Silvestrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The design and operation of two scintillation cameras being built at the Frascati National Laboratory for use with the Frascati synchrotron are described. Some preliminary considerations on the desired characteristics for automatic and semi-automatic analysis of scintillation photographs are briefly discussed. (J.S.R.)

25941 (NP-11977(p.120-1)) MISURA DELLA POLARIZZAZIONE DEL PROTONE DI RINCULO NELLA FOTO-

PRODUZIONE DI π^0 NELLA REGIONE DELLA PRIMA RISONANZA. (Measurement of the Polarization of Recoil Protons in the Photoproduction or π^0 in the Region of the Primary Resonance). R. Bizzarri, E. Di Capua, U. Dore, G. C. Gialanella, P. Guidoni, I. Laakso, and G. C. Moneti (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The polarization of protons in the photoproduction of π^0 was investigated for γ energies in the region of the primary resonance. The γ energy was established at 350 Mev and the proton angle at 90° in the center-of-mass system. The experimental setup using the He bubble chamber was described. An evaluation is given of the number of events needed to give statistical accuracy. (J.S.R.)

25942 (NP-11977(p.121-3)) INTERACZIONE PERIFERICA NELLA FOTOPRODUZIONE DOPPIA DI PIONI CARICHI. (Peripheral Interaction in the Double Photoproduction of Charged Pions). D. Boccaletti (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

The process $\gamma + p \rightarrow p + \pi^- + \pi^+$ was studied with a consideration of the peripheral interaction at high energy. The energy spectra of the final π^- at fixed laboratory angles and the angular cross section of π^- at fixed laboratory angles were calculated and the curves obtained are given for an energy of 900 Mev. The energy spectra were corrected for the peripheral interaction. (J.S.R.)

25943 (NP-11977(p.124-6)) ALCUNI PROBLEMI RIGUARDANTI LA FOTOPRODUZIONE DI PIONI IN IDROGENO E DEUTERIO E LA RELATIVA SPERIMENTAZIONE. (Some Problems Regarding the Photoproduction of Pions in Hydrogen and Deuterium and the Pertinent Experimentation). M. Beneventano, R. Finzi, L. Mezzetti, and L. Paoluzi (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

An experimental apparatus for the measurement of the differential cross section for the single photoproduction of charged pions is described. The γ energy is between 500 and 1000 Mev. The study has the purpose of verifying the maximum in the angular distribution predicted by Drell. The deuterium experiment has the purpose of providing data on the reaction $\gamma + n \rightarrow \pi^- + p$ in comparison with the reactions $\gamma + p \rightarrow \pi^+ + n$. (J.S.R.)

25944 (NP-11977(p.127-9)) VERIFICA DELLA CONSERVAZIONE DELLA PARITA' NELLA RE AZIONE $\gamma + P \rightarrow \pi^+ + \pi^-$ P. (Verification of Parity Conservation in the Reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$). A. Forino, E. Fuschini, C. Maroni, and P. Veronesi (Italy. Istituto Nazionale di Fisica Nucleare, Bologna).

In the study of parity conservation in $\gamma + p$ reactions various counter arrangements were compared. Polythene targets were used in such a way as to simulate effective targets of liquid H_2. The preliminary results obtained are briefly discussed. (J.S.R.)

25945 (NP-11977(p.129-35)) ATTIVITA' DEL GRUPPO CAMERE A DIFFUSIONE E A BOLLE DELLA UNIVERSITA' DI GENOVA. (Activity of the Bubble and Diffusion Chamber Group of the University of Genoa). P. E. Argan, G. Bendiscioli, A. Gigli, A. Piazzoli, E. Picasso (Italy. Istituto Nazionale di Fisica Nucleare, Genoa), G. Ciocchetti, and G. Piragino (Italy. Istituto Nazionale di Fisica Nucleare, Turin).

A brief survey is given of the work being done by the bubble and diffusion chamber group at the University of Genoa. The topics discussed are simple and multiple photoproduction of π mesons in H_2, D_2, and heavy nuclei, ionization measurement in a gaseous bubble chamber, study of the dynamic growth processes of a bubble in a highly supersaturated gas-liquid mixture, and photoproduction of heavy mesons and hyperons and analysis of K^+ decay products. (J.S.R.)

25946 (NP-11977(p.135-7)) PROGRAMMA PRELIMINARE DI RICERCHE SULLA FOTOPRODUZIONE DI K^+. (Preliminary Research Program on the Photoproduction of K^+). B. Borgia, M. Grilli, L. Mezzetti, N. Nigro, and S. Tazzari (Italy. Istituto Nazionale di Fisica Nucleare, Padua and Italy. Istituto Nazionale di Fisica Nucleare, Rome).

As a preliminary to the study of K^+ photoproduction, the experimental results obtained in this field at Cornell and Cal. Tech. are compared. The theoretical understanding of this reaction is considered briefly without discussion of the validity of perturbation calculations. (J.S.R.)

25947 (NP-11977(p.137-9)) FOTOPRODUZIONE DI MESONI K IN IDROGENO. (Photoproduction of K Mesons in Hydrogen). A. Manfredini, M. Mucknik, I. Quassiati, and M. Severi (Italy. Istituto Nazionale di Fisica Nucleare, Rome).

Cross sections for the photoproduction of K mesons in H_2 for angles > 90° in the laboratory system is being measured with nuclear emulsions. The exposure conditions that give the best compromise between the intensity of the electron background and the density of the K mesons are discussed with respect to the emulsion type. The values calculated for the dependence on γ energy and angle in the baricenter in which the K meson is emitted as a function of track length are tabulated. (J.S.R.)

25948 (NP-11977(p.140-4)) MISURE DI VITA MEDIA DI MESONI π SU TRAITETTORIA RETTILINEA E CIRCOLARE. (Measurement of the Mean Life of π Mesons in Rectilinear and Circular Trajectories). M. Ageno (Italy. Istituto Superiore di Sanita, Rome), E. Amaldi (Rome. Universita. Istituto di Fisica), B. Rispoli (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Casaccia), and G. Sanna (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

The theoretical bases that must be considered in the design of a timing device for the measurement for the mean life of π mesons are discussed. (J.S.R.)

25949 (NP-11977(p.144-6)) PROGRAMMA DI ESPERIMENTI IN COLLABORAZIONE FRASCATI-NAPOLI-ROMA SULL' INTERAZIONE DI FOTONI DI ALTA ENERGIA CON NUCLEI PESANTI. (Experimental Program in the Frascati-Naples-Rome Collaboration on the Interaction of High Energy Photons with Heavy Nuclei). G. Cortini (Italy. Istituto Nazionale di Fisica Nucleare, Naples).

A brief review is made of the results obtained in studies of the interaction of high-energy photons with heavy nuclei. Topics discussed are the production of stars in nuclei emulsions and experiments on photoproduction. The cross sections for the photofission of U^{238}, Th^{232}, and Bi^{209} are given. (J.S.R.)

25950 (PAN-279/I-A) WARSAW CENTRE OF ATOMIC NUCLEUS PHYSICS. Zdzisław Wilhelmi (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1961. 31p.

A review of progress at the institute of nuclear research is presented. The survey is devoted exclusively to the development of atomic nucleus physics. A bibliography of publications during the period 1955 to 1961 is included. (J.R.D.)

25951 (R62SD64) ELECTRON DISTRIBUTION FUNCTION AND ELECTRICAL CONDUCTIVITY OF A SLIGHTLY IONIZED GAS. Douglas H. Sampson and Jacob Enoch (General Electric Co. Missile and Space Div., Val-

ley Forge Space Technology Center, King of Prussia, Penna.). June 1962. 35p.

An expansion of a formally rigorous integral solution of the Boltzmann equation in powers of the electric field and m/M was used to demonstrate clearly the correct expression for the conductivity of a spatially homogeneous slightly ionized gas. The conditions under which the isotropic part of the electron distribution function reduces to the Margenau distribution were determined. A discussion of the physical reasons for the possibility of negative conductivity is given. (auth)

25952 (TID-16011) EXPERIMENTAL AND THEORETICAL HIGH ENERGY PHYSICS. Progress Report. David Feldman and Anatole M. Shapiro (Brown Univ., Providence). June 1, 1962. Contract AT(30-1)-2262. 24p.

Progress on experimental and theoretical research on high-energy nuclear and meson physics is reported. (M.C.G.)

25953 (TID-16079) RESEARCH IN NUCLEAR PHYSICS. Progress Report No. 12. (Purdue Research Foundation, Lafayette, Ind.). June 15, 1962. Contract AT(11-1)-123. 94p.

Research progress is reported on nuclear reaction studies, angular correlation and Mossbauer effect studies, and nuclear spectroscopy. (M.C.G.)

25954 (TID-16225) APPLICATION OF NUMERICAL METHODS TO THE THEORY OF THE PERIODIC DEVIATIONS IN THE SCHOTTKY EFFECT. Geneva G. Belford, Aron Kuppermann, and T. E. Phipps (Illinois. Univ., Urbana. Noyes Lab. of Chemistry). [nd]. Contract [AT (11-1)-691]. 33p.

Results are reported for a new theoretical calculation of the periodic deviations from the Schottky line. Numerical methods exclusively were used to solve the Schrödinger equation for the emitted electron, to obtain transmission coefficients, and to calculate emitted current by averaging transmission coefficient over an appropriate electron energy distribution. The numerical calculations were carried out both for a simple-image-force potential barrier and for a similar potential differing only in having a small dip at the metal surface. Results for the simple-image-force potential were in complete agreement with previous analytic results, yielding Schottky deviations of approximately the right period and amplitude but shifted in phase by about a quarter-period from experimentally determined deviations. In disagreement with an earlier analytic-numerical study, results for the slightly altered potential were nearly identical to the simple-image-force results and showed the same phase shift. (auth)

25955 (UCRL-6925) AN UPPER LIMIT TO THE PRODUCTION OF H^+ FROM H_2 BY ELECTRON BOMBARDMENT. G. O. Brink and F. S. Baker (California. Univ., Livermore. Lawrence Radiation Lab.). June 1, 1962. Contract W-7405-eng-48. 8p.

An upper limit to the ratio of H^+ to H_2^+ produced by electron bombardment of H_2 was measured. The measurement was made by a crossed-beam technique using a modulated beam of molecular hydrogen and a d-c beam of electrons. The result obtained is that the upper limit of this ratio is about 0.16. A comparison of this result with previous measurements is made and discussed. (auth)

25956 (UCRL-10097) A HYDRODYNAMIC MECHANISM FOR THE COALESCENCE OF LIQUID DROPS (thesis). Sidney B. Lang (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1962. Contract W-7405-eng-48. 265p.

The coalescence of liquid drops at planar interfaces was studied theoretically and experimentally. The mechanism of coalescence was found to occur in two parts. In the first part, the drop (phase 1) approaches the interface through the continuous medium (phase 2) and deforms the interface by creating a spherical depression in it. The thin spherical shell of phase 2 material between the drop and the interface is slowly squeezed out under the combined action of surface and gravity forces. The phase 2 film becomes thinner at a rate inversely proportional to the cube of its thickness. When the film becomes sufficiently thin, the second part of the mechanism occurs. Because a denser liquid always overlies a less dense liquid at one of the interfaces of the film, the interface is inherently unstable with respect to long-wavelength disturbances (Taylor instability). If such a disturbance is introduced into the proper interface, the disturbance will grow exponentially in time until the film disintegrates, causing coalescence of the drop. A sufficiently intense disturbance of any wavelength can also rupture the metastable film, causing coalescence. The ease of rupture of the phase 2 film increases with decreasing thickness of the film. The disturbances can originate from any source yielding a fluctuating pressure at the interface, i.e., mechanical vibration, thermal convection currents, Marangoni instability, or other. Drop rest-times were predicted to decrease with decreasing drop radius, decreasing phase 2 viscosity and decreasing frequency of disturbance. The effect of density difference and interfacial tension depends upon whether film thinning or film rupture is the rate-determining step in coalescence. Coalescence measurements were made in an all-glass thermostatted cell. The two-component systems water-benzene, water-anisole, ethylene glycol-benzene, tributyl phosphate-water, and water-Aroclor 1248 were studied. Both artificial sonic and artificial subsonic disturbances were found to decrease the drop rest-times. Measurement of the natural sonic pattern present in the coalescence cell by means of a special microphone showed the presence of intense but short-time disturbances. Studies with surfactants showed that concentrations of less than 0.02 mM of surface-active agent in the water-benzene system could increase coalescence times by a factor of 2. Experimental changes in drop size and system properties agreed with the theory, qualitatively. Because of the microscopic nature of the theory and the macroscopic nature of the experimental results, exact experimental verification of the theory is not possible. (auth)

25957 (FTD-TT-62-637) CURRENT OSCILLATIONS IN A THERMIONIC ENERGY-CONVERTER SYSTEM CONTAINING CESIUM VAPOR. N. D. Morgulis, S. M. Levitskii (Levitskiy), and I. N. Groshev. Translated from Radiotekh. i Elektron., 7: 352-3(1962). 4p.

Results are given of an investigation concerning high-frequency current oscillations which can arise during operating of a Cs-vapor thermionic diode for converting thermal energy to electric energy. (J.R.D.)

25958 (JPRS-13656) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS MINISTRY OF HIGHER EDUCATION, RADIOPHYSICS SERIES. VOL. IV, NO. 5, 1961. Translation of Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz. 4: No. 5, 795-985(1961). 445p.

A complete translation is presented for the journal Izvestiya Vysshikh Uchebnykin Zavedeniy, MVO, Vol IV, No. 5, 1961. Twenty-two papers are included on the following topics: use of the surface impedance concept in the theory of surface electromagnetic waves, connection between the sporadic radio emission from the sun and the state of the ionosphere, instability of magnetoactive plasma against high-frequency electromagnetic disturbances, st-

ionation and growth of plasma waves, effect of electrostatic instabilities on electric conductivity and temperature of a plasma, interaction between electron beam and electromagnetic waves in an anisotropic dielectric, "flicker" of artificial source of light, theory of spontaneous decay of quantum systems, observation of mutation in experiments on nuclear magnetic resonance, form of oscillations of spectral line, magnetic-sound oscillations in resonators, absorption of magnetic-sound waves in waveguides, multiconductor lines consisting of round wires, electromagnetic waves in a low-loss inhomogeneous non-linear medium, possibility of comparison of three-dimensional electromagnetic systems with inhomogeneous anisotropic filling, effective self-inductance coefficient of thin wires, use of antenna pattern scanning in certain radioastronomic observations, scattering of sound by turbulent compressible stream, fluctuations in a long line, characteristics of interaction between an electron beam and a dielectric slow-wave structure in the form of a thin-wall cylinder in a metal waveguide, efficiency of a two-cavity klystron at large output-signal amplitudes, and expression for electron interaction power in terms of surface integrals. Separate abstracts were prepared for 7 papers. (M.C.G.)

25959 (JPRS-13656(p.1-91)) USE OF THE SURFACE IMPEDANCE CONCEPT IN THE THEORY OF SURFACE ELECTROMAGNETIC WAVES. M. A. Miller and V. I. Talanov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

Several problems in the theory of surface electromagnetic waves, connected with the impedance description of the directional properties of the separation boundary, are reviewed. Topics covered include propagation of free surface waves, excitation by specified extraneous sources, and transformation of surface waves into spatial waves and vice versa. A bibliography with 227 references is included. (M.C.G.)

25960 (JPRS-13656(p.137-63)) INSTABILITY OF MAGNETOACTIVE PLASMA AGAINST HIGH-FREQUENCY ELECTROMAGNETIC DISTURBANCES. [PART] IV. V. V. Zheleznyakov (Zheleznyakov). Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

Using the expression derived by Landau for the coefficient of growth of electromagnetic waves propagating in a non-equilibrium plasma along a magnetic field, a criterion was derived in explicit form for the instability in two limiting cases. In the first case the distribution function of the momenta of the plasma particles is such that a wave of frequency Ω is irradiated essentially by particles with constant longitudinal momentum. In the second case the frequency is connected principally with particles having the same transverse momentum. (auth)

25961 (JPRS-13656(p.164-76)) ON THE QUESTION OF ATTENUATION AND GROWTH OF PLASMA WAVES. A. A. Andronov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

Einstein's quantum theory method was used to obtain the attenuation (growth) coefficient of longitudinal waves in an equilibrium isotropic plasma and in a plasma broached by an electron beam. The electron energy losses connected with radiation of longitudinal waves were calculated. (auth)

25962 (JPRS-13656(p.177-92)) EFFECT OF ELECTROSTATIC INSTABILITIES ON ELECTRIC CONDUCTIVITY AND TEMPERATURE OF A PLASMA. V. D. Shapiro. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

Electrons accelerated by the field of a plasma placed in a strong electric field formed a beam and built up longitudinal oscillations of the plasma. The slowing down of the electron beam as a result of interaction with the collective oscillations of the plasma was determined, as was the increase in the thermal energy of the plasma particles as a result of thermalization of the oscillations. The variation of the distribution function of the plasma electrons in the course of time was obtained by solving an equation similar to the Fokker-Planck equation, in which the collective collisions in the plasma were taken into account. (auth)

25963 (JPRS-13656(p.193-218)) INTERACTION BETWEEN ELECTRON BEAM AND ELECTROMAGNETIC WAVES IN AN ANISOTROPIC DIELECTRIC. P. V. Bliokh and E. A. Kaner. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

The interaction between an electron beam and electromagnetic waves in an unbounded anisotropic dielectric was considered in the linear approximation. The dependence of the amplification coefficients in space and the time buildup on the angles that characterize the directions of wave propagation and beam propagation in a uni-axial crystal were investigated. By graphical analysis of the dispersion relation, the character of the instability of the beam was classified. It is shown that, depending on the relation between the beam parameters and the dielectric parameters, the instability can be both absolute and convective. (auth)

25964 (JPRS-13656(p.233-59)) ON THE THEORY OF SPONTANEOUS DECAY OF QUANTUM SYSTEMS. F. V. Bunkin. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

The spontaneous decay of an arbitrary isolated quantum system, specified in terms of its Hamiltonian, was considered. The general formulation of the decay problem necessitated, first, a more precise definition of the decay concept itself, and second, a special analysis of methods used to describe the initial state of the decaying system. Expressions were obtained for the probability of decay of an arbitrary system, generalizing the well-known Fok-Krylor theorem, which pertains to a particular type of decay, namely the decay of the ψ state. (auth)

25965 (JPRS-13656(p.260-78)) OBSERVATION OF NUTATION IN EXPERIMENTS ON NUCLEAR MAGNETIC RESONANCE. N. M. Nevskaya, V. I. Kvlividze, and R. M. Umarkhodzhaev (Umarkhodzhayev). Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 4: (1961).

The form of the signals of absorption and dispersion, arising in a strong high-frequency magnetic field was investigated. The approximate expressions were obtained for the form of the absorption signals and for the dispersion, in the particular case when the relaxation times are equal, and are compared with the experimental data. The conditions under which nutation of the magnetization vector can occur were derived. A method was proposed for determining the amplitude of the high-frequency magnetic field from a measurement of the nutation frequency. (auth)

25966 A SIMPLIFIED METHOD OF OBTAINING THE INFINITESIMAL OPERATORS OF THE HOMOGENEOUS LORENTZ GROUP. I. PHYSICAL FOUNDATIONS. B. Kuchowicz (Inst. for Nuclear Research, Polish Academy of Sciences, [Warsaw]). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 10: 221-4(1962). (In English)

A physically motivated approach is used to derive the infinitesimal operators of the proper homogeneous Lorentz group. Formulas are found showing the way in which the space and time components of the angular momentum tensor operator act on the canonical basis vectors, using a derivation employing Clebsch-Gordan coefficients. (T.F.H.)

25967 ON THE GAUGE CONDITIONS IN QUANTUM ELECTRODYNAMICS. I. Białynicki-Birula (Inst. of Theoretical Physics, Warsaw). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 10: 225-7(1962). (In English)

A formulation of quantum electrodynamics in terms of Feynman integrals over all paths is proposed, which utilizes gauge restrictions on the integration paths. In the derivation, the gauge restrictions on the potentials have the same form and meaning as in classical theory; in the special case of the Lorentz gauge, the formalism is explicitly Lorentz-invariant. The method used to introduce the gauge restrictions is to impose them as added conditions on the generating functional of all Green's functions. (T.F.H.)

25968 THE VAPOUR PRESSURE OF SOLID AND LIQUID NEON. E. R. Grilly (Los Alamos Scientific Lab., N. Mex.). Cryogenics, 2: 226-9(June 1962).

Vapor pressures were measured from below the triple point to the critical point. A cylindrical copper block containing one drilled hole for the vapor pressure cell and another to hold the resistance thermometer was used. The block could be cooled rapidly by an exchange gas within the jacket, which was surrounded by a liquid hydrogen bath. During measurements, the jacket was evacuated. Results are presented in graphical and tabular forms. (L.N.N.)

25969 MAGNETIC MEASUREMENTS OF PULSE CONTROLLED IRON CORES. G. Kaes. Elektronische Rundschau, 15: 517-20(Nov. 1961). (In German)

Tape-wound cores were investigated for their applicability to pulsed operation. The controlling high-voltage power pulses were varied in duration, rise time, and amplitude. Measured were the flux vs pulse duration and vs rise time as well as the loss vs flux. The construction and operation of a power-pulse generator developed for the application and featuring continuous adjustments of the pulse duration from 0.2 to 2.5 μs and of the pulse repetition frequency from 200 to 5000 pps is described. (auth)

25970 RELIABILITY OF THE HELLMANN-FEYNMAN THEOREM FOR APPROXIMATE CHARGE DENSITIES. L. Salem and E. Bright Wilson, Jr. (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 36: 3421-7(June 15, 1962).

A spherical atom in a uniform external field and the long-range interaction of two molecules are examples which illustrate the unreliability of the Hellmann-Feynman theorem when applied to systems described by approximate wave functions or charge densities. However, in the first case a wave function correct to first order in the perturbing field and in the second case a wave function correct to second order in the mutual interaction will yield the correct force. For spherical atoms in an external field, the contribution of the continuum states to the electronic screening of the field is very large, 54% for hydrogen and about 72% for helium. From this case also one can evolve general considerations concerning the use of effective nuclear charges in electrostatic force calculations. In the general case it is shown that for a system submitted to a given perturbation the wave function correct to order n, or the corresponding charge density, yields the force correct to order n and to order n only. This result leads to a brief comparison of the Hellmann-Feynman procedure and the variational method. (auth)

25971 A NOTE ON THE THEORETICAL EFFICIENCY FOR ENERGY TRANSFORMATION USING THERMIONIC EMISSION. J. Myatt and L. G. Sanders (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Electronics and Control, 11: 95(Aug. 1961).

It is theoretically shown that when diodes are used as energy transducers, a low cathode work function (e.g., equal to the anode work function) is not compatible with low efficiency. (auth)

25972 DIRECT CONVERSION OF FISSION HEAT TO ELECTRIC POWER. P. D. Dunn (Atomic Energy Research Establishment, Harwell, Berks, Eng.), G. Rice, L. G. Sanders, D. A. Watt, J. Adam, R. J. Hill, J. G. Purchas, C. C. H. Wheatley, and J. A. McWilliams. Nature, 195: 65-6(July 7, 1962).

Experiments were performed in the reactor Pluto as a stage in the development of cesium neutralized diodes for the direct conversion of fission heat to electric power. Due to its greater cathode area, the device produced a larger value of output current than previously reported. Measurements were made with two rigs, the object being to test the fuel rod material and method of mounting, to determine temperature distributions and heat transfer data, and to study the performance of the diodes as generators. The highest value of current achieved was 140 amp (14 amp/cm^2) with the variable gas pressure rig. (P.C.H.)

25973 QUASI-TRAPPING OF LOW-ENERGY ELECTRONS IN WATER VAPOUR. G. S. Hurst, L. B. O'Kelly, and J. A. Stockdale (Oak Ridge National Lab., Tenn.). Nature, 195: 66-7(July 7, 1962).

The interaction of low-energy (less than 1 ev) electrons with water vapor was examined by means of a swarm method in which water vapor at pressure f_1p was added to ethylene, carbon dioxide, and methane, at pressures f_2p. It was found that when f_1p ranged from 1 to 16 mm Hg, no electron capture occurred for an E/P [V cm^{-1} (mm Hg)$^{-1}$] ranging from 0.01 to 4.0. However, significant increase in the electron transport time was observed for mixtures of water and ethylene. The results suggest that electrons make collisions of long duration with water and that the lifetime of the quasi-trap $[H_2O]^-$ is limited by collision with ethylene for the pressure ranges quoted. The nature of the force involved in the primary collision process is thought to be that of an electron-permanent electrical dipole interaction. Essential differences in the quasi-trap, $[H_2O]^-$, and the polaron are emphasized. (P.C.H.)

25974 CONTRIBUTION TO THE FLUORESCENCE OF RARE EARTHS. H. Witzmann and H. R. Mueller-Buschbaum (Universität, Greifswald, Ger.). Naturwissenschaften, 49: 180(1962). (In German)

The fluorescence of trivalent Sm in alkaline earth borates, alkaline earth phosphates, and alkali earth and alkaline earth mixed borates was investigated. Comparison of the fluorescence of the Sm-activated alkaline earth borates with lead and Tl activated systems showed a relationship between the spectral position of the Sm line and the structure of the microcrystalline force field found in the immediate vicinity of the activator. It was shown that the energy transfer of the Sm spectra under the effect of cerium can be traced back to the formation of the heterotype mixed phase $CeO_2 - Sm_2O_3$. The transfer of the spectral position and intensity of the Sm lines were investigated as functions of the compositions of the systems $(CeO_2 - ThO_2) - Sm$ and $(CeO_2 - La_2O_3) - Sm$. The intensity of the Sm emission passes through a maximum in $(CeO_2 - ThO_2) - Sm$. (J.S.R.)

25975 LUMINESCENCE OF COPPER- AND COPPER-LEAD-ACTIVATED STRONTIUM BORATE PHOSPHORS. H. Witzmann and H. Schreiter (Universität, Greifswald, Ger.). Naturwissenschaften, 49: 181-2(1962). (In German)

A copper-activated Sr borate was prepared and the luminescence in the visible wave lengths after excitation with a mercury vapor lamp was determined as a function of copp

concentration. Increasing copper concentration amplified the emission bands with maxima at 4150 and 6100 Å. With lead as a second activator, the long-wave band of the copper emission was amplified. Three emission maxima were found at 3100, 4150, and 6100 Å. In opposition to the acid Sr borates, the basic Sr borates are not activated with copper. (J.S.R.)

25976 PHASE SEPARATION OF DILUTE MIXTURES OF He^4 IN He^3. D. F. Brewer and J. R. G. Keyston (Oxford Univ.). Phys. Letters, 1: 5-6(Apr. 1, 1962). (In English)

In cooling He^3 below 1°K by adiabatic demagnetization, slow demagnetization yields a temperature drop down to about 0.15°K, at which point a rapid warm-up occurs. This warm-up is interpreted as the phase separation of the He^4 impurity (X = about 0.066 at.% He^4) from the He^3 to form a thin film of almost pure superfluid He^4 on the container walls. This film then causes thermal contact between the He^3 and the bath at 1°K, thus causing the observed warm-up. The observed phase separation temperature of 0.15°K is compared with the prediction of the theoretical expression $1 - X = 1.13T^{-\frac{3}{2}} \exp(-0.71/T)$ which yields T = 0.153°K. (T.F.H.)

25977 THE CRYSTAL STRUCTURE OF SOLID HYDROGEN. J. Van Kranendonk and H. P. Gush (Univ. of Toronto). Phys. Letters, 1: 22-3(Apr. 1, 1962). (In English)

The $S_1(0)$ infrared absorption line of para H_2 is caused by the transition $\underline{v} = 0$, $\underline{J} = 0 \rightarrow \underline{v} = 1$, $\underline{J} = 2$, and the rate of this transition is governed by the square of the sum of the dipole moments induced by the quadrupole field of the absorbing molecule in all the neighboring molecules. If the absorbing molecule is situated at a center of inversion symmetry, this sum and the $S_1(0)$ intensity vanish. The observation of the $S_1(0)$ line is taken as evidence that the structure of solid para H_2 cannot be body centered tetragonal, but probably is hexagonal-close-packed. The effects of additions of less than about 2% ortho H_2 are also considered. (T.F.H.)

25978 EXPERIMENTAL DETERMINATION OF THE PRINCIPAL OPTICAL FREQUENCIES OF CaF_2. D. Cribier, B. Farnoux, and B. Jacrot (Centre d'Etudes Nucléaires, Saclay, France). Phys. Letters, 1: 187-8(June 15, 1962). (In French)

The principal frequencies of CaF_2 are measured by means of inelastic scattering of slow neutrons, using a time-of-flight spectrometer. The crystal has two distinct optical modes of vibration. One mode induces a modulation of the polarizability tensor of the lattice, and is active in the Raman effect; it has a value of 9670 kMc. The second mode electrically polarizes the medium, and is itself divided into two types of vibrations. The first type is transverse, and is responsible for infrared absorption; it has a value of 7750 kMc (40 μ). The second type is longitudinal, and creates a mean electric field in the crystal; its value is 14,360 kMc. (T.F.H.)

25979 OBSERVATION OF OPTICAL AND ACOUSTICAL MAGNONS IN MAGNETITE. H. Watanabe and B. N. Brockhouse (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Letters, 1: 189-90(June 15, 1962). (In English)

Part of an optical spin-wave branch believed to correspond to the ω_2 branch (H. Kaplan, Phys. Rev. 86: 121(1952)) was observed. The whole of the acoustic (ω_1) branch in the [011] direction was disclosed. The triple-axis spectrometer at the NRU reactor was used. The low-energy part of the acoustic branch was studied under high resolution, using the rotating-crystal spectrometer; results agree with other measurements. (L.N.N.)

25980 REMARKS ON THE QUANTUM MECHANICAL INTERPRETATION OF THE STARK EFFECT IN THE HYDROGEN ATOM. L. B. Rédei (Univ. of Uppsala). Phys. Letters, 1: 191-2(June 15, 1962). (In English)

When applying perturbation theory in the quantum mechanical treatment of the Stark effect, the perturbation expansion diverges. A plausible modification of the boundary conditions makes the power series convergent at least for those states associated with the quantum numbers n = 1, 2, 3, 4, to about 10^5v cm^{-1} field strength. For n = 1, the radius of convergence is at least 2.5×10^6v cm^{-1}. (L.N.N.)

25981 LATTICE IMPERFECTIONS, ISOTOPIC ORDERING AND NUCLEAR SPIN INTERACTION IN SOLID HELIUM AS SHOWN BY SPECIFIC HEAT MEASUREMENTS. D. O. Edwards, A. S. McWilliams, and J. G. Daunt (Ohio State Univ., Columbus). Phys. Letters, 1: 218-20(June 15, 1962). (In English)

Specific heat measurements were performed on He^3 and He^4 at 0.06 to 1°K, using a calorimeter consisting of a Cu sponge of free volume 0.318 cm^3 with pores of 10μ, made by sintering uniform particles of Cu powder inside a copper cup. Above 0.3°K, results for solid He^4, β He^3, and α He^3 fit the Debye T^3 law, and ^0D values agree with data. Existence of an "Einstein" or "Schottky" term in the thermal capacity of solid α He is confirmed. Data compare favorably with theory; data and calculations are presented in graphical and tabular forms. (L.N.N.)

25982 QUANTIZATION OF MAGNETIC FLUXES IN SUPERCONDUCTORS. W. Weller (Karl-Marx Universität, Leipzig). Phys. Letters, 1: 222-3(June 15, 1962). (In German)

The Green function for superconductors is investigated; the magnetic flux is quantized at 0°K to T_c. The Gorkov formula for the Bardeen-Cooper-Schrieffer theory is used (L. P. Gorkov, Zhur. Eksptl'. i Teoret. Fiz. 34: 735(1958)). (L.N.N.)

25983 LIFETIME EFFECTS IN CONDENSED HELIUM-3. Pierre Morel (French Embassy, New York) and Philippe Nozières. Phys. Rev., 126: 1909-18(June 15, 1962).

The condensation of a Fermion system by forming d-type bound pairs is discussed using time-dependent correlation functions at absolute zero and finite temperatures, for applying this study to the case of liquid helium-3. Gor'kov's method, suitably generalized to take into account the anisotropy of the bound pairs and the finite lifetime of the quasi-particles which make up the pairs essentially, is used. The treatment proposed goes one step further than the Hartree approximation in the sense that the finite decay rate of the quasi-particles is introduced by a model spectral density for the renormalized propagator (Green's function). This model features a single broad peak instead of the infinitely sharp peak which characterizes the Hartree approximation. This microscopic model is related to data on the scattering probability in liquid helium-3. The effect of scattering on the condensation can be described by a cutoff Λ of about 1°K, limiting the domain in momentum space of the quasi-particles which participate effectively in the condensation process. This entails a reduction of the transition temperature estimated on the basis of the Hartree approximation, down to 0.02 to 0.03°K. (auth)

25984 MOBILITY OF IONS IN LIQUID He^4I AND He^3 AS A FUNCTION OF PRESSURE AND TEMPERATURE. L. Meyer, H. T. Davis, Stuart A. Rice, and R. J. Donnelly (Univ. of Chicago). Phys. Rev., 126: 1927-34(June 15, 1962).

The pressure and temperature dependence of the mobility of the positive and negative species of charged particles in liquid He^4 above the λ transition and in liquid He^3 were

studied. The mobility of the positive species in He^4 decreases linearly with increasing density, and the Stokes radius of the positive species is inversely proportional to $T^{1/2}$. The mobility of the negative species initially increases with increasing density and then falls off linearly with further increase in density. The Stokes radius of the negative species increases with increasing temperature. At constant density, the mobilities of both species in He^4 and He^3 vary very slowly with temperature. At the vapor pressure and around 2.2°K, there is a larger temperature dependence, but this is probably due to the approach of the λ transition. The mobility of the positive species in He^4 and He^3 at 3.0°K is a linear function of density, independent of the isotope. Feynman suggested a model for the negative species in which an electron is trapped in a bubble of radius b. Comparison shows that this model is not able to account for the temperature and pressure dependence of the observed mobility. An electron would not diffuse by quantum mechanical tunneling from cavity to cavity. An expression for the mobility of the negative species was derived by assuming that the negative species is a free electron and that scattering is determined by a small pseudopotential equal to the polarization potential outside an atom and zero inside the atom. A mobility initially increasing with increasing density at constant temperature was proposed, but the decrease of mobility with further increase in density cannot be predicted unless a density-dependent effective mass of the electron is assumed. The effective mass necessary to fit theory to experiment is approximately 100 electron masses and is proportional to the square of the density. (auth)

25985 LOW-TEMPERATURE PARAMAGNETIC RELAXATION OF COLOR CENTERS IN KCl. W. D. Ohlsen and D. F. Holcomb (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 126: 1953-62(June 15, 1962).

The spin-lattice relaxation of color centers in KCl was experimentally studied at liquid helium temperatures by following the recovery of the magnetization after saturation of the electron spin resonance. X-irradiated and additively colored crystals were studied and found to behave in the same manner. For crystals containing only F centers, the recovery rates were roughly proportional to the F-center concentration. A tendency toward concentration independence at the lower concentrations was observed. The most dilute system studied had about 8×10^{16} F centers/cc, and showed a relaxation rate at 2°K of 2.2×10^{-3} sec^{-1}. Measurements at 1.4°K indicated a linear temperature dependence for the relaxation rate. A crystal containing 3×10^{18} F centers/cc showed an initial recovery rate of about 0.1 sec^{-1}. The recovery was non-exponential, and the terminal recovery rate was about 0.03 sec^{-1}. Measurements at the same temperatures as those used for the dilute system showed the relaxation rate to be temperature independent. Samples of intermediate concentration gave a smooth transition between these two types of behavior. Measurements in magnetic fields of 3500 and 1750 gauss indicate a field-independent relaxation rate for all samples. After optical bleaching in the F absorption band, with concomitant production of M, R, and N centers, crystals showed an increased recovery rate for both the initial and terminal portions of the recovery. As bleaching progressed, the recovery became more nonexponential and less temperature dependent. Increases in relaxation rates by factors of several hundred were observed with no signs of saturation of the effect. Subsequent thermal bleaching of M, R, and N centers restored the relaxation rate to its value prior to optical bleaching. Details of sample preparation are given, as is a discussion of possible explanations of the results. (auth)

25986 THEORY OF EXCHANGE RELAXATION OF HYPERFINE STRUCTURE IN ELECTRON SPIN RESONANCE. James D. Currin (Stanford Univ., Calif.). Phys. Rev., 126: 1995-2001(June 15, 1962).

The electron spin exchange interaction between colliding molecules is examined as a possible relaxation mechanism for the hyperfine structure of free-radical molecules in solution. An expression is derived which, under suitable conditions, relates the frequency-dependent susceptibility to a single parameter q, which can be interpreted as the frequency of spin exchanges. For large values of q the absorption narrows to a single line of width σ^2/q, where σ is the mean square width of the unperturbed spectrum. For small values of q, the widths of the individual hyperfine lines depend upon their relative intensities. Results are compared with experiments. (auth)

25987 THEORY OF SUPERCONDUCTIVITY. I. ELECTRON-LATTICE INTERACTION. R. K. Nesbet (Boston Univ.). Phys. Rev., 126: 2014-20(June 15, 1962).

The electron-lattice interaction responsible for electrical resistivity in perfect metallic crystals is a form of Jahn-Teller effect. It does not occur in the Born-Oppenheimer (adiabatic) approximation, even when the electron-electron interaction is considered. The matrix elements that describe corrections to the Born-Oppenheimer approximation are derived by a general argument that can be applied to metals with arbitrary electronic energy band structure, and the case of monatomic metals is worked out in the effective mass approximation. Two types of physical phenomena are attributed to these matrix elements. The first is ordinary electrical resistivity due to electron-phonon scattering. The derivation leads to the same formal structure as the usual theory, but should give quantitatively different results when applied to specific metals. The second is a modification to the stationary states of the electron-lattice system that can alter the total energy spectrum at low energies, and mixes states of electron excitation and lattice excitation. This can account qualitatively for the disappearance of electrical resistivity at finite temperatures in superconductors. Other special properties of superconductors should follow from consideration of the stationary states modified by the Jahn-Teller effect. (auth)

25988 MAXIMUM VARIATIONAL PRINCIPLE FOR CONDUCTION PROBLEMS IN A MAGNETIC FIELD, AND THE THEORY OF MAGNON DRAG. M. Bailyn (Westinghouse Research Labs., Pittsburgh). Phys. Rev., 126: 2040-54(June 15, 1962).

A maximum variational principle is applicable for conduction problems (including "drag" effects) in the presence of a magnetic field. The part of the diagonal tensor element that is even in the magnetic field is maximized. The relation between the "high-field" and the variational method is pointed out, the latter being applied to accommodate open orbit effects, and to obtain interpolation formulas to span high- and low-field solutions (keeping in view the phonon drag effects). Standard operator expansion techniques are useful for obtaining solutions for the high-field limit. Symmetry considerations are facilitated by using operators suggested by the variational problem, and if no drag effects are present and a time of relaxation permitted, new relations emerge for the cross coefficients connecting the charge flow and temperature gradient. Because the scattering by spin waves is analogous to the scattering of phonons, (since double-magnon processes are negligible at low temperatures), the theory of "magnon-drag" follows precisely that of phonon drag, and the effects can be automatically incorporated in all the expressions. (auth)

25989 ELECTRON ENERGY DISTRIBUTION IN SLIGHTLY IONIZED AIR UNDER THE INFLUENCE OF ELECTRIC AND MAGNETIC FIELDS. N. P. Carleton and L. R. Megill (National Bureau of Standards, Boulder, Colo). Phys. Rev., 126: 2089-99(June 15, 1962).

Numerically-computed solutions to the Boltzmann equation were obtained giving the electron energy distribution in weakly ionized air assuming that there are present a static magnetic field and an electric field of constant direction (perpendicular to the magnetic field) and a constant rms value, that the gas is homogeneous and the fields uniform in space, that the degree of ionization is weak enough so that electron-electron and electron-ion collisions are negligible, that the fields are such that the average electron energy is much larger than the thermal energy of the gas molecules and the heating of the gas by the electrons is negligible, that processes of creation and removal of free electrons are negligible, and that electrons may lose energy in elastic collisions and may also excite rotational, vibrational, and electronic degrees of freedom. To describe these energy-loss processes, experimental cross sections are used. We take the constituents of the air to be N_2, O_2, and O, the later being included for upper atmosphere applications. Distribution functions for limiting cases are given and comparisons are made of solutions to others obtained by less extensive calculations. While the ratio of electric field to pressure is a good scaling factor for d-c excitation, this is not the case if either the excitation frequency or the gyro frequency is large compared to the collision frequency. (auth)

25990 SCATTERING OF OXYGEN IONS FROM ARGON AND XENON. J. G. Kelley, F. E. Steigert, and W. W. Watson (Yale Univ., New Haven). Phys. Rev., 126: 2100-5 (June 15, 1962).

The forward-angle elastic scattering of 153-Mev oxygen ions from a natural argon target was measured and is compatible with the predictions of the sharp-cutoff model using a cutoff l value of 60 and a diffuseness parameter of 3.5. The forward-angle elastic scattering from a natural xenon target was similarly fitted, using a cutoff l value of 91. These would correspond to radius parameters r_0 of the order of 1.43 and 1.47 f, respectively. A survey of the reaction products observed in scattering O^{16} ions from a target of enriched Ar^{40} is also reported. (auth)

25991 WAVE EQUATIONS IN CURVED SPACE-TIME. S. Datta Majumdar (University Coll. of Science, Calcutta). Phys. Rev., 126: 2227-30(June 15, 1962).

The wave equation for the electron in a gravitational field is generalized for all elementary particles. Conditions for the Lorentz invariance of a first-order equation are sufficient for the generalization. (auth)

25992 NEW TECHNIQUE FOR CALCULATING CORRELATIONS FOR VACANCY DIFFUSION. H. B. Huntington and P. B. Ghate (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev. Letters, 8: 421-3(June 1, 1962).

A method is described for calculating correlation factors for diffusion of vacancy-impurity pairs. The calculation is shown for the case in which the correlation is neglected unless the vacancy and impurity are nearest neighbors, but the correlations may have much longer ranges. The case of graphite-type structure is considered as an example. The method is applicable to both isotropic and anisotropic diffusion. (T.F.H.)

25993 CORRELATION BETWEEN HEAT CAPACITY ANOMALY IN Tb AND MAGNETIC TRANSITION IN Tb_2O_3. B. C. Gerstein, F. J. Jelinek, and F. H. Spedding (Ames Lab., Ames, Iowa). Phys. Rev. Letters, 8: 425(June 1, 1962).

The magnetic susceptibility of Tb_2O_3 is measured from 1 to 25°K and found to have a maximum at 2.42°K. This maximum falls within 0.02°K of an anomalous transition in the heat capacity of Tb. (T.F.H.)

25994 STRUCTURE OF THE γ FORM OF SOLID He^4. A. F. Schuch and R. L. Mills (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 8: 469-70(June 15, 1962).

The γ phase of solid He^4 is studied by x-ray diffraction experiments. Diffraction lines are observed that are interpreted as 110 and 200 reflections from a bcc structure. The length of the bcc cell edge and the molar volume inferred from the data are 4.11 Å and 20.91 cm^3 respectively. By comparison of the α and γ phase diffraction patterns, a volume change for the α–γ transition of 0.21 cm^3/mole is calculated. (T.F.H.)

25995 SPIN-LATTICE RELAXATION IN MULTILEVEL SPIN SYSTEMS. R. Orbach (Harvard Univ., Cambridge, Mass.) and M. Blume. Phys. Rev. Letters, 8: 478-80 (June 15, 1962).

The possibility of a temperature dependence for the spin-lattice relaxation time (τ_1) containing terms proportional to T^{-5} and T^{-7}, arising from two-phonon Raman processes in multilevel spin systems, is introduced. The T^{-5} dependence is considered to be stronger in the second and third transition groups and the rare earths than in the first transition group, and is dominant only in the low-temperature part of the Raman spectra. The T^{-5} dependence arises for the case in which a ground-state (non-time-reversed) Kramers doublet undergoes a spin-lattice relaxation process in the presence of a third level that is nearby in energy (e.g., another member of the ground-state multiplet). (T.F.H.)

25996 THERMAL CONDUCTIVITY AND PHONON RESONANCE SCATTERING. R. O. Pohl (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 8: 481-3(June 15, 1962).

The thermal conductivity of KNO_2-doped KCl crystals is measured at 1 to 100°K, for NO_2^- ion concentrations of 0 to about 4×10^{19} cm^{-3}. A resonance interaction between the nonparamagnetic NO_2^- ion and lattice phonons is observed, with a maximum for phonon frequencies corresponding to a temperature of about 8°K. The relaxation time associated with these defects is determined as a function of the phonon frequency, and is calculated to be 1.8×10^{-10} sec at the resonant frequency. A theoretical model is used to calculate the thermal conductivity as a function of temperature and impurity concentration; the experimental and calculated curves for given concentration show almost identical behavior. (T.F.H.)

25997 OBSERVED SIGN REVERSAL OF A MAGNETIC FIELD PENETRATING A SUPERCONDUCTOR. K. E. Drangeid and R. Sommerhalder (Zurich Research Lab.). Phys. Rev. Letters, 8: 567-9(June 15, 1962).

An external 0.11-Mc axial magnetic field (H_a), with a peak value up to 30 Oe, is applied to superconducting Sn cylinders having wall thicknesses of 3.10 to 1.87 μ. The internal field (H_i) produced in the interior of the cylinders is studied at 2.2 to 3.8°K. The apparatus used can measure H_a/H_i ratios as high as 10^3, which value is attained upon cooling down to 3.4°K. The phase shift between H_a and H_i is found to be 0° at 3.41°K and 180° at 2.88°K. (T.F.H.)

25998 OBSERVATION OF QUANTUM PERIODICITY IN THE TRANSITION TEMPERATURE OF A SUPERCONDUCTING CYLINDER. W. A. Little and R. D. Parks

(Stanford Univ., Calif.). Phys. Rev. Letters, 9: 9-12 (July 1, 1962).

Quantum periodicity in the transition temperature was observed in a thin cylinder of tin. A clearly defined series of parabolic variations of the transition temperature was noted as the magnetic field was changed. The parabolas were regularly spaced at intervals of hc/2e in the magnetic flux, agreeing with data on quantized flux (B. S. Deaver and W. M. Fairbank, Phys. Rev. Letters, 7: 43 (1961); R. Doll and M. Näbauer, Phys. Rev. Letters, 7: 51(1961)). Data are presented in graphical form. (L.N.N.)

25999 PARAMAGNETISM OF Fe IMPURITIES IN TRANSITION METALS. P. P. Craig, D. E. Nagle, W. A. Steyert, and R. D. Taylor (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. Letters, 9: 12-14(July 1, 1962).

Hyperfine splitting of Fe^{57} nuclei as a function of an external field H and of temperature was studied. The internal field is proportional to the (time) average of the z component of the Fe^{57}; measurements of the splitting permit determination of the electronic polarization of Fe. In certain metals, the splitting vanishes in zero external field at 1.5 to 4°K and increases as the external field is increased to saturation, corresponding to complete polarization, at large fields and low temperatures. The splitting is a function of H/T, and may be represented by Brillouin functions. The local magnetic moment, the associated angular momentum, and the saturated internal field are parameters of the Brillouin function. (L.N.N.)

26000 MEASUREMENTS ON THE K FLUORESCENCE YIELD OF Cr, Mn, Cu, AND Ga. P. Kramer, A. De Beer, E. C. Bos, and J. Blok (Vrije Universiteit, Amsterdam). Physica 28: 582-6(June 1962).

With a double proportional flow counter absolute counting of both K x rays and K Auger electrons can be achieved in the energy region 5 to 12 kev, using argon-methane as filling gas at pressures up to 20 atm. Absolute counting of Auger electrons is only achieved if the counter was filled with helium gas. By comparing the two counting rates accurate values for the K fluorescence yield (ω_K) of some elements can be obtained by measuring isotopes decaying by electron capture. The results are: $\omega_K(Cr) = 0.222 \pm 0.003$; $\omega_K(Mn) = 0.273 \pm 0.003$; $\omega_K(Ga) = 0.457 \pm 0.004$; and $\omega_K(Cu) = 0.400 \pm 0.004$. (auth)

26001 INSTRUMENTATION FOR ROCKET MEASUREMENTS OF THE FREE-ELECTRON DENSITY IN THE IONOSPHERE. K. I. Gringauz, V. A. Rudakov, and A. V. Kaporskii. Planetary and Space Sci., 9: 247-57(May 1962).

An outline is given of the rocket-borne radio transmitters and transmitting antennae, the ground receiving antennae, the receiver-phase-metering equipment, and the recording and auxiliary equipment used in rocket measurements of the electron density variations in the ionosphere. The density-measurement method depends on the detection and recording of phase-difference changes of two coherent r-f signals emitted from the rocket and received on the ground. This phase difference arises as a result of wave dispersion by the electrons in the ionosphere. The radio frequencies employed are 24, 48, and 144 Mc. (T.F.H.)

26002 CONSIDERATIONS ON HELIUM EMISSION λ10830Å IN AURORAE. E. E. Ferguson (Univ. of Texas, Austin). Planetary and Space Sci., 9: 286-7(May 1962).

The hypothesis that part of the He 10830-Å emission in sunlit aurorae arises from the fluorescent scattering of sunlight from He in the 2^3S state is considered. In order that the observed and theoretical number of 10830-Å quanta arising in a column with a 1-cm^2 base agree with one another, the average lifetime of the 2^3S He must be taken as 10^3 sec. The lifetime of 2^3S He is calculated from cross sections for Penning collisions (i.e., collisions in which the neutral collision partner, such as O_2, N_2, or atomic O, is ionized and the metastable atom is de-excited). These calculations show that the 2^3S He average lifetimes assumed in the auroral studies are at least 2 orders of magnitude too large, and that the validity of the hypothetical emission mechanism is therefore in doubt. (T.F.H.)

26003 THE MANY ELECTRON WAVE EQUATION IN THE SCHRÖDINGER-PAULI FORM. K. S. Viswanathan (National Aeronautical Lab., Bangalore, India). Proc. Indian Acad. Sci., 55: Sec. A, 261-79(May 1962). (In English)

The reduction of the generalized Dirac equation for a system containing N electrons to its 2^N large components is considered. The wave equation for many-electron systems is derived in its Schrödinger-Pauli form, and this derivation includes relativistic effects such as the mass change of the particles with their velocities and the spin-orbit, orbit-orbit and spin-spin interactions. Remarks are made on the physical interpretation of the components of the wave function and the relations they should obey in order to satisfy the Pauli Exclusion Principle. (auth)

26004 HARTREE-FOCK AND CORRELATION ENERGIES FOR 1s2s ^3S AND ^1S STATES OF HELIUM-LIKE IONS. C. S. Sharma and C. A. Coulson (Oxford Univ., Eng.). Proc. Phys. Soc. (London), 80: 81-96(July 1, 1962).

The energies of the 1s2s ^3S and ^1S excited states of an atom of nuclear charge Z are calculated in the form of a series in ascending powers of 1/Z. The first four terms in the series for these non-relativistic, but otherwise exact, energies are obtained numerically. The corresponding zeroth-order and first-order wave functions are calculated-the former exactly, and the latter by a variational method-using up to twelve variable parameters. The energies of these states are also calculated within the Hartree–Fock scheme. A misunderstanding in the Hartree–Fock equations for the excited singlet state is corrected, and the zeroth-order and first-order wave functions are calculated exactly. Formulae are obtained from which, by numerical integration, these Hartree–Fock energies may be computed in a power series similar to that for the exact energy. Electron correlation is very small for the triplet, but larger for the singlet. Both values, however, are much less than those for the $1s^2$ ground state. (auth)

26005 THE CORRELATION ENERGIES OF THE HELIUM SEQUENCE. W. B. Somerville and A. L. Stewart (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 80: 97-102(July 1, 1962).

An attempt is made to determine with high accuracy the effect of configuration interaction in the second-order term, in the expansion of the energy of the ground state of two-electron systems in inverse powers of Z. The equations for the separate angular harmonics of the first-order wave function are solved variationally using expansions in terms of one-electron orbitals, with the object of examining the rate of convergence as the number of orbitals in the trial solution is increased. The convergence of the harmonic expansion is found to be slow, the contributions falling off as $0.35\ l^{-4}$. The radial expansion is also slowly convergent particularly in the case of the high-order harmonic contributions with $l \geq 5$. Comparison with a similar calculation using an expansion in terms of Hylleraas coordinates indicates that the interelectron separation is a basis function, which gives accurately the contributions of the high-order harmonics to the second-order correlation energy. The calculations show that the contributions to the second-order energy from radial and angular correlation are

-0.0286 and −0.0647 rydberg respectively, compared to the Hartree–Fock contribution of −0.2220 rydberg. (auth)

26006 LIQUID-VAPOUR EQUILIBRIUM IN HELIUM II. D. V. Osborne (Univ. of British Columbia, Vancouver). Proc. Phys. Soc. (London), 80: 103-9(July 1, 1962).

The rate at which helium atoms are exchanged between liquid helium II and its vapor is discussed and compared with the rate at which momentum is exchanged between liquid and vapor. Evidence is drawn from experiments on evaporation, second sound, and film flow, and it is concluded that the vapor exchanges momentum with the normal fluid only. (auth)

26007 A VARIATIONAL CALCULATION OF THE GROUND STATE ENERGY OF LIQUID HELIUM. S. F. Edwards and M. J. Halsall (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 80: 110-15(July 1, 1962).

The variational approach to a many-boson system is carried through by the explicit evaluation and variation of the energy using a simple choice of variational function. The trial function is very crude in comparison with that required for an adequate discussion of liquid helium, but it is still a true many-body function. The agreement of the result with the experimental constants of liquid helium is adequate considering this crudity. (auth)

26008 THEORY OF TEMPORAL GROWTH OF IONIZATION BETWEEN PARALLEL PLATES IN THE INERT GASES. P. M. Davidson (University College of Swansea, Wales). Proc. Phys. Soc. (London), 80: 143-50(July 1, 1962).

It is suggested that, in addition to the secondary ionization processes caused by the action on the cathode of positive ions and undelayed radiation, a number of other secondary and collisional processes must be taken into account in the rare gases. These processes include the conversion of atomic ions into molecular ions and metastable atoms into metastable molecules, and the transition of atoms from metastable and resonant states with production of undelayed photons. Moreover, it is suggested that the transfer of resonant photons through the gas takes place in accordance with a particular theory, and also that delayed radiation (that is, radiation from excited states that have a long lifetime) may be of importance. On the assumption that all these processes are active, formulae are derived for the current growth between parallel plates arising from specified causes, such as an externally generated cathode electron current of given strength maintained since time zero, or the liberation of a single electron at time zero. The procedure by which these formulae are derived is general, and is not confined to the particular processes enumerated. (auth)

26009 BETA RECOIL FROM SOLID SURFACES. D. L. Baulch and J. F. Duncan (Univ. of Melbourne). Proc. Roy. Soc. (London), A268: 181-204(July 10, 1962).

The frequency with which the ThC(Bi^{212}) and RaC(Bi^{214}) β-recoil atoms escape from surfaces is used to calculate the apparent binding energies of the bismuth atoms to the surfaces. The results are compared with the heats of adsorption of the daughter species on the surface determined from the amount of daughter distilled from the surface at different temperatures. It is shown that the chemical nature of the surface determines the recoil yield, the magnitude of which is comparable with that expected from the binding energy of the daughter atom on the surface. In the case of mica, comparison of the surface binding energies determined by recoil and by thermal desorption leads to the conclusion that there could be two adsorption sites of widely differing energy present on the surface. (auth)

26010 ON THE ENERGY GAP IN SUPERCONDUCTING TIN. C. J. Adkins (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), A268: 276-89(July 10, 1962).

The surface resistance of superconducting tin and of tin–indium alloys was measured at a frequency of 140 kmc/s and at temperatures near to the superconducting transition. In both single crystal and polycrystalline alloy specimens, the onset of quantum absorption was well defined and corresponded to an isotropic energy gap with a value at absolute zero of about $3.6kT_c$. With pure tin, however, the absorption edge was not well defined in specimens oriented away from the tetrad axis; but near to the tetrad axis, there seems to be a considerable region in which the gap varies comparatively slowly, taking a value of about $3.6kT_c$. Assuming that the absence of a clearly defined absorption edge for other orientations is the result of gap anisotropy, it is shown that regions in which the gap takes values very different from $3.6kT_c$ must lie well away from the tetrad axis. The analysis also shows that such regions are comparatively unimportant, and that the $3.6kT_c$ gap predominates strongly. (auth)

26011 ON THE INVARIANT SPATIAL DISTANCE IN A CURVED SPACE-TIME WITH SPHERICAL SYMMETRY. Hidekazu Narlai (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 27: 483-510(Mar. 1962). (In English)

Two kinds of the invariant spatial distance based on the geodesic deviation of null-geodesics in a curved space-time with spherical symmetry are studied. There is an intimate connection between the definability of these two spatial distances and the space-time structure. This assures adequacy that the concept of invariant spatial distance could be a powerful tool in the researches on the space-time structure. Results can be utilized in the problem of the allowable mean value for the invariant spatial distances among several observers and for other problems. (auth)

26012 THE EXPECTATION VALUE OF A MANY-BODY HAMILTONIAN IN THE QUASI-CHEMICAL EQUILIBRIUM THEORY. James McKenna (Bell Telephone Labs., Inc., Murray Hill, N. J.) and John M. Blatt. Progr. Theoret. Phys. (Kyoto), 27: 511-28(Mar. 1962). (In English)

For studying the Meissner effect in superconductivity, a Hamiltonian is considered that includes Coulomb and electron-phonon interactions. The expectation value of this Hamiltonian is evaluated in the quasi-chemical equilibrium approximation to statistical mechanics. A compact expression is obtained for the expectation value of the Hamiltonian which may be useful in a variational treatment of the Meissner effect. (auth)

26013 THEORY OF DYNAMICAL BEHAVIORS OF FERROMAGNETIC SPINS. Hazime Mori and Kyozi Kawasaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 529-70(Mar. 1962). (In English)

The dynamical behavior of ferromagnetic spins is studied from statistical mechanics of irreversible processes. A macroscopic equation determining the change in time of an inhomogeneous magnetization is derived giving explicit expressions for the frequency spectrum and damping constant. Using the general expressions, the pair correlation of spins, the magnetic scattering cross section of neutrons, the frequency spectrum and the damping constant of spin waves, and the damping of the longitudinal spin component above and below the Curie point are discussed on the basis of the Heisenberg model of ferromagnetic spins. In the low temperature limit, a straightforward reduction of the expressions leads to the spin wave frequency and damping equivalent to Dyson's theory of spin wave interactions. A general expression is given for van Hove's parameters de-

scribing the asymptotic behavior of the spin pair correlation at large distances. The longitudinal spin damping in the low-temperature limit exhibits k dependences, depending upon the relative magnitudes of the spin wave energy Dk^2, the effective magnetic field H coming from other than the exchange interaction and the thermal energy k_BT; in particular, for $g\mu_BH \ll Dk^2 \ll k_BT$, the longitudinal damping is proportional to k^2, namely, the change in time of the longitudinal spin density obeys the diffusion equation. Near the Curie point and in the paramagnetic region, the longitudinal damping obeys the diffusion equation. The diffusion constant vanishes at the Curie point and agrees with values for iron above the Curie point. (auth)

26014 STATISTICAL DYNAMIC BEHAVIORS OF A ONE-DIMENSIONAL LATTICE WITH AN ISOTOPIC IMPURITY. Shohei Kashiwamura (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 571-88(Mar. 1962). (In English)

Equations of motion of a harmonically-coupled, one-dimensional lattice are exactly solved for a lattice containing an isotopic impurity particle of arbitrary mass. Statistical dynamical properties of the system are investigated by introducing an initially canonical ensemble. The time series of displacement and velocity of a particle in the lattice constitute the stationary Gaussian processes, whose statistical properties, i.e. the ergodicity, non-Markovian properties and the approach to the equilibrium distribution are discussed. The approach to the equilibrium (Maxwellian distribution) fails when the system has a localized vibrational mode. (auth)

26015 SELF-CONSISTENT FIELD THEORY FOR ELECTRONS IN SOLIDS. Sigeru Huzinaga (Kyushu Univ., Fukuoka). Progr. Theoret. Phys. (Kyoto), 27: 693-706 (Apr. 1962). (In English)

The Hartree-Fock self-consistent field theory is developed for electrons in solids in terms of the Wannier functions. The advantage of the Wannier function over the Bloch function for the specific purpose is stressed. Using Roothaan's method, in which the Wannier functions are expanded in terms of a set of suitable basic functions, solving the Hartree-Fock equations for electrons in solids appears to be within reach of large computers. (auth)

26016 ON THE INVARIANT SPATIAL DISTANCE IN A CURVED SPACE-TIME WITH SPHERICAL SYMMETRY. II. THE PROBLEM OF THE ALLOWABLE MEAN VALUE FOR THE DISTANCES AMONG SEVERAL OBSERVERS. Hidekazu Nariai and Yoshio Ueno (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 27: 707-31(Apr. 1962). (In English)

The allowable mean value for the invariant spatial distances among several observers in a class of the space-time having spherical symmetry is discussed. Except in a few cases, the functional form of the allowable mean value and the metric tensor for the space-time under consideration can be determined simultaneously. Results are applied to various space-times present in cosmology. (auth)

26017 EFFECT OF COULOMB INTERACTION ON ANOMALOUS SKIN EFFECTS. Sadao Nakajima and Mitsuo Watabe (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 27: 842-3(Apr. 1962). (In English)

Many-body correlation effects on transport phenomena result from the self-energy effect described by the quasi-particle picture and from the two-body (electron-electron, hole-hole, or electron-hole) correlation effect that cannot be included in the one-particle picture. There is no correction in the extreme anomalous limit; ambiguity exists in the choice of the boundary condition. It is shown that this ambiguity can be removed by calculating the frequency and wave number dependent conductivity $\sigma_\omega(q)$ (S. Nakajima, Progr. Theoret. Phys., 23: 694(1960)). The boundary condition is considered when the Maxwell equation coupled with the generalized Ohm law is solved. The general formula of conductivity and the method of Green functions are used. (L.N.N.)

26018 ON THE MOVEMENTS OF ARC CATHODE SPOT AND OF BALL-OF-FIRE IN A TRANSVERSE MAGNETIC FIELD. Nobukazu Miyagawa. Sci. Papers Inst. Phys. Chem. Research (Tokyo), 56: 47-50(Mar. 1962). (In English)

Movements seem to be caused by the resultant pondermotive force given to the cathode spot or ball-of-fire by the following particles: impact ions in the case of cathode spot, and impact electrons and probably also projected ions in the case of ball-of-fire (these charged particles may impinge on or be projected to the Amperian side); and evaporating molecules from the cathode spot or ball-of-fire to the Amperian and the opposite sides. Atmospheric molecules may always impede the movement of cathode spot or ball-of-fire. Forward as well as retrograde movements of both cathode spot and ball-of-fire can be explained with this idea. (auth)

26019 SPATIAL DISTRIBUTION OF PARTICLES IN THE METHOD OF COLLECTIVE VARIABLES. I. R. Yukhnovskii. Ukrain. Fiz. Zhur., 7: 267-77(1962). (In Russian)

The free energy of a classical system consisting of spatially distributed ions and dipoles is calculated. For a self-consistent Debye potential an approximate expression is obtained, which coincides in form with the self-consistent potential of a system of ions in which the medium is taken into account through a dielectric constant. The complete description of the dielectric properties of the solvent (the dipole system) is given by group integrals. The Debye free energy is represented in the form of a series by group integrals. (auth)

26020 IONIZATION OF ATOMIC AND MOLECULAR BEAMS WITH A PLASMA ION SOURCE. Jagdish Chander (Universitat, Erlangen-Nurnberg, Ger.). Z. Physik, 167: 533-48(1962). (In German)

A method for ionizing atomic and molecular beams is described, in which use is made of a space charge compensated plasma ion source of the duoplasmatron type. In such a device the ionization yield (ionization and extraction efficiency) can be increased considerably as compared to that in conventional electron bombardment ionizers. The maximum yield of H_2^+ ions from a H_2 molecular beam was 3.7%. Further results are contained in a table. (auth)

26021 ELECTRON CAPTURE BY HELIUM IONS IN VARIOUS GASES IN THE 300–1500 kev ENERGY RANGE. L. I. Pivovar, M. T. Novikov, and V. M. Tubaev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1490-4(June 1962). (In Russian)

Measurements are made on the effective cross sections for capture of one (σ_{21}) or two (σ_{20}) electrons by doubly-charged helium ions in single collisions in hydrogen, helium, nitrogen, argon, and krypton. The measurements are carried out for He^{2+} ion energies at 300 to 1500 kev. (auth)

26022 ION PRODUCTION BY ELECTRON IMPACT. R. I. Reed. London, Academic Press, 1962. 249p. 45s.

Ionization and appearance potential measurements and energetic deductions are explained, and theoretical considerations for production of cations and anions are dis-

cussed. Thermochemical deductions and mass spectra for inorganic compounds are considered. Molecular ion energies, stabilities, and rearrangement occurrences and the quasi-equilibrium theory are discussed for organic molecules. Cracking patterns are surveyed, and recognition of structural elements from the cracking pattern is outlined. (L.N.N.)

26023 PERTURBATION THEORY AND THE NUCLEAR MANY BODY PROBLEM. Kailash Kumar. From the Series in Physics. Amsterdam, North-Holland Publishing Co. and New York, Interscience Publishers, Inc., 1962. 342p. $9.75.

Techniques in applying perturbation methods to many-body problems are analyzed. A unified derivation of perturbation expansions is given; algebraic properties, modifications, and rearrangements of these series, especially the Brillouin-Wigner and Rayleigh-Schrödinger series, are discussed. Diagram techniques are presented, and theorems and formulas for large Fermion systems are proved. Techniques for solving the equations and application of the theory to nuclear matter and nuclei are presented. Qualitative features are summarized. Connections of these methods to other approaches are discussed. (L.N.N.)

26024 ATOMIC AND MOLECULAR PROCESSES. Pure and Applied Physics. A Series of Monographs and Textbooks. D. R. Bates, ed. New York, Academic Press Inc., 1962. 904p.

Radiative and collisional processes involving atoms and molecules are discussed; theoretical and experimental aspects are included. Electron and heavy-particle collisional processes at thermal and high energies, radiative processes, and collisional broadening of spectral features are explained; high-temperature shock waves are discussed. Twenty-one articles are included; all are separately abstracted for NSA. (L.N.N.)

26025 FORBIDDEN TRANSITIONS. R. H. Garstang (Univ. of London). p.1-46 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Forbidden lines in atomic spectra and transitions in diatomic and polyatomic molecular spectra and in crystals are discussed. Forbidden transitions in astrophysical phenomena are explained. (L.N.N.)

26026 ALLOWED TRANSITIONS. R. W. Nicholls (Univ. of Western Ontario, London) and A. L. Stewart. p.47-78 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Atomic and molecular line-strength calculation methods are explained, and transition probability measurements are discussed. (L.N.N.)

26027 PHOTOIONIZATION PROCESSES. R. W. Ditchburn and U. Oepik (Univ. of Reading, Eng.). p.79-99 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Measurements of absorption coefficients and ionization currents are discussed. Recombination spectra are explained, and products are analyzed. (L.N.N.)

26028 PHOTODETACHMENT. L. M. Branscomb (National Bureau of Standards, Washington, D. C.). p.100-40 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Results from negative-ion spectroscopy and physical principles inferred from observations and theory are summarized. Atomic-ion spectra are emphasized. Data on electron affinities are presented in tabular form. (L.N.N.)

26029 HIGH-TEMPERATURE SHOCK WAVES. Alan C. Kolb and Hans R. Griem (U. S. Naval Research Lab., Washington, D. C.). p.141-205 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Shock tubes can be used to investigate high-temperature, high-velocity gas flow. The shock tube as a device for precision determination of atomic properties is considered, including atomic transition probabilities (f numbers) and line-broadening coefficients (damping constants and shape functions). Information on atomic and ionic wave functions can thus be obtained. (L.N.N.)

26030 ATTACHMENT AND IONIZATION COEFFICIENTS. A. N. Prasad (Univ. of Liverpool) and J. D. Craggs. p. 206-44 of "Atomic and Molecular Processes. New York, Academic Press Inc., 1962.

Electron attachment cross sections and coefficients are summarized. The relation of primary and secondary ionization coefficients to attachment coefficients is discussed. (L.N.N.)

26031 ELECTRONIC RECOMBINATION. D. R. Bates and A. Dalgarno (Queen's Univ., Belfast). p.245-71 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Electrons and cations may unite by collisional-radiative recombination (a complex process tending to radiative recombination in the low plasma density limit and to collisional recombination in the high plasma density limit) or by a process (such as dielectric recombination or dissociative recombination) involving a free-bound radiationless transition. Calculations and data are presented. (L.N.N.)

26032 IONIC RECOMBINATION. J. Sayers (Univ. of Birmingham, Eng.). p.272-9 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Two- and three-body ionic recombination processes are described. General considerations and experimental investigations are discussed. Data are presented in graphical and tabular forms. (L.N.N.)

26033 ELASTIC SCATTERING OF ELECTRONS. B. L. Moiseiwitsch (Queen's Univ., Belfast). p.280-334 of "Atomic Molecular Processes." New York, Academic Press Inc., 1962.

Electron elastic scattering by potential fields, hydrogen atoms, complex atoms and ions, and molecules is described. Cross-section measurement methods are discussed. (L.N.N.)

26034 THE MOTIONS OF SLOW ELECTRONS IN GASES. L. G. H. Huxley (National Univ., Canberra, Australia) and R. W. Crompton. p.335-73 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Motions of slow electrons in gases and physical quantities associated with electron reactions with gas molecules are investigated. A stream of electrons, having entered a diffusion chamber through an aperature in its cathode, proceeds through the gas to the anode in a uniform electric field. The mean speed of drift W of the electrons in the field is much less than the average of their speeds of random motion. As the stream proceeds to the anode, it also spreads by diffusion, with a coefficient of diffusion D, so that the current received by the anode is distributed broadly, in general, over its surface. By dividing the anode symmetrically (a central disk and concentric annuli, or a central strip flanked by parallel strips) into insulated sections, the ratio of the currents to any two sections can be measured and the ratio W/D for the stream can be calculated. (L.N.N.)

26035 THE THEORY OF EXCITATION AND IONIZATION BY ELECTRON IMPACT. M. J. Seaton (Univ. Col-

lege, London). p.374-420 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Classical, general-quantum, and partial-wave theories are discussed. Cross-section calculation and measurement methods are considered, and collisional excitation is treated as a radiative process. (L.N.N.)

26036 THE MEASUREMENT OF COLLISIONAL EXCITATION AND IONIZATION CROSS SECTIONS. Wade L. Fite (General Dynamics Corp., San Diego). p.421-92 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Measurement methods for electron, ion, and neutral impact studies and for electron reactions with ions are discussed. (L.N.N.)

26037 SPECTRAL LINE BROADENING IN PLASMAS. M. Baranger (Centre d'Études Nucléaires, Saclay, France). p.493-548 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Causes of line broadening in ionized gases, quantum-mechanical system spectra, the classical path assumption, and limiting approximations are considered. The impact approximation, its corrections, and its application to broadening by electrons are discussed. Broadening by ions is explained. Calculations are compared with data. (L.N.N.)

26038 THEORETICAL TREATMENT OF COLLISIONS BETWEEN ATOMIC SYSTEMS. D. R. Bates (Queen's Univ., Belfast). p.549-621 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Wave and impact-parameter treatments of the first Born approximation are considered. The second Born and special higher approximations are discussed. Charge transfer, spin-change collisions, pseudocrossing of potential energy surfaces, ionization, detachment, and resonance effects are explained for slow reactions. (L.N.N.)

26039 RANGE AND ENERGY LOSS. A. Dalgarno (Queen's Univ., Belfast). p.622-42 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Except at high energies, where bremsstrahlung is the dominant energy-loss process, electrons passing through a material lose energy almost entirely through excitation and ionization of particles in the material. When the electron velocity is reduced to the point at which excitation and ionization are no longer energetically possible, the attenuation continues through momentum transfer in elastic collisions until thermal equilibrium with the material is attained. For heavy charged particles, the incident particles may also be excited and ionized and may capture electrons from the atoms of the material; bremsstrahlung is never an important loss mechanism. (L.N.N.)

26040 DIFFUSION AND MOBILITIES. A. Dalgarno (Queen's Univ., Belfast). p.643-62 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

The diffusion coefficient and cross section are discussed; methods for their calculation under various conditions are explained. If particles of a gas are charged and a small electric field is applied, the particles acquire a drift velocity proportional to the magnitude of the electric field. The constant of proportionality is the drift velocity; this constant is proportional to the diffusion coefficient. (L.N.N.)

26041 HIGH-ENERGY ELASTIC SCATTERING OF ATOMS, MOLECULES, AND IONS. Edward A. Mason (Univ. of Maryland, College Park) and Joseph T. Vanderslice. p.663-95 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

The elastic scattering of high-energy atoms, molecules, and ions by gases leads to information on forces between the interacting particles. Experimental methods used in studies with monoenergetic beams are described, and the elementary classical theory of scattering is reviewed. Data are presented and analyzed. (L.N.N.)

26042 CHARGE TRANSFER AND COLLISIONAL DETACHMENT. John B. Hasted (Univ. College, London). p.696-720 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Semi-empirical theories for reactions between complicated systems are developed. Collision chamber techniques, mass analysis, symmetrical resonance charge transfer, charge transfer reactions between unlike systems, crossovers, and negative ions and collisional detachment are considered. (L.N.N.)

26043 ELECTRON CAPTURE AND LOSS AT HIGH ENERGIES. Samuel K. Allison and M. Garcia-Munoz (Univ. of Chicago, Ill.). p.721-82 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Reactions in which the number of electrons bound to atomic projectiles above 0.2 kev is changed are discussed. Calculation and measurement techniques are described; results are presented in graphical and tabular forms. (L.N.N.)

26044 RELAXATION IN GASES. J. D. Lambert (Univ. of Oxford, Eng.). p.783-806 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

The interchanges of translational, vibrational, and rotational energy between molecules in collision are considered. Internal energy relaxation at a particular instant is that which occurs when the vibrational or rotational temperature of the gas differs from the translational temperature. Associated phenomena are discussed. (L.N.N.)

26045 CHEMICAL PROCESSES. J. C. Polanyi (Univ. of Toronto). p.807-55 of "Atomic and Molecular Processes." New York, Academic Press Inc., 1962.

Reactions rates are considered. Theory and measurement of reaction rate dependence on concentrations, temperature, and kinematic factors are discussed. (L.N.N.)

Astrophysics and Cosmology

26046 (AFCRL-834) AN EXAMPLE OF CHROMOSPHERIC STRIATION OBSCURATION BY A GREAT FLARE. GRD Research Notes No. 68. Henry J. Smith and William D. Booton (Air Force Cambridge Research Labs., Geophysics Research Directorate, Bedford, Mass.). Aug. 1961. 16p. (AD-269222)

Certain great solar flares produce a temporary obscuration or disruption of the neighboring chromospheric striation patterns. These patterns are basically hydrodynamic phenomena, but are closely linked to the local magnetic field. Hence their behavior is important to an understanding of the physical processes in flares. Seventeen great flares on Sacramento Peak films were examined for this effect. One outstanding example was found on 6 May 1960; this case is described in detail. Evidence clearly shows that the effect results from local obscuration by flare surge material in the corona; it is not necessary to invoke any catastrophic change in the magnetic field. (auth)

26047 (FTD-TT-62-165) IONIZED METEOR TRAIN. V. E. (Ye.) Shteptan. Translated from Astron. Tsirkulyar, No. 208, 25-6(1960). 3p.

Certain regularities in the appearance of ionized trains with meteors were deduced from extensive information obtained with binoculars from August 1952 through September 1959 at the city of Chardzhow are discussed. A sharp drop was noted in the per cent of meteors with trains at bright-

nesses of meteors at 6.0 and above star magnitudes. An empirical relation was obtained between the train duration and the stellar magnitude of the meteor. (M.C.G.)

26048 ON THE CONFIGURATION OF RELATIVISTIC PARTICLES GENERATED BY A SUPERNOVA IN THE GALACTIC ARM. M. Oda and H. Hasegawa (Tokyo Univ.). Phys. Letters, 1: 239-40(June 15, 1962). (In English)

A postulate on the existence of an arm or a local arm extending from the neighborhood of the solar system toward a direction of about 5° galactic longitude is discussed. The postulate resulted from an interpretation of the "spur-shaped" region on the radio map of the sky in terms of the synchrotron radiation from a configuration of cosmic particles injected by a supernova into the magnetic field of a galactic arm (M. Oda and H. Hasegawa, J. Phys. Soc. Japan, 17: 171(1962)). (L.N.N.)

26049 THE LUNAR ATMOSPHERE. E. J. Oepik (Univ. of Maryland, College Park and Armagh Observatory, Northern Ireland). Planetary and Space Sci., 9: 211-44 (May 1962).

Optical and radio estimates of the upper limit of density of the lunar atmosphere are reviewed. Properties of the lunar ionosphere in contact with the surface are analyzed theoretically and applied to an estimate of its composition and density. Considering the balance between injection and escape, the daytime average probable number density at the surface is rated at 3 to 5 × 10^5 cm^{-3}, with an uncertainty ratio of about 2 and with 50 to 70 per cent CO_2, 45 to 27 per cent H_2O, and 2 to 4 per cent H_2. The electron density in equilibrium with contact recombination at the surface, is then 200 to 300 cm^{-3}. The sources of the atmosphere are solar wind, its interaction with and sputtering of the surface, meteor impact degassing, and somewhat dubious "volcanic" sources. The surface electric charge is slightly negative or neutral; only when the total density falls below 1×10^6, and the electron density below 200, is there a positive charge. The photoelectric efficiency of silicates is estimated to be of the order of 1/80, and the electron emission as depending on surface potential is estimated accordingly from the solar ultraviolet emission. Mechanisms of escape—thermal, collision with solar wind, and ionic—are evaluated quantitatively. Thermal escape prevails for hydrogen; the other two processes for the heavier molecules. The longest escape time scale is about 2 years for xenon, provided the layer is thin (exospheric). No permanent atmosphere can exist on the moon. The conditions of static and escaping plasma equilibrium are reviewed. Conservation of space charge in an escaping plasma stream requires the establishment of turbulent electric fields which force the electrons to oscillate with thermal velocities around the mean motion determined by the momentum of the ions. The fields prevent direct escape of the photoelectrons from the lunar surface, and play a decisive role in the structure of the lunar ionosphere. From cometary phenomena and optical data for the zodiacal light the persistent and principal component of solar wind is estimated to correspond to N_e = 50 cm^{-3}, v = 200 km/sec, a relative electron temperature of about 400 to 500°K at the earth's orbit, and a translational energy of 210 ev for the protons and ~1000°K for the electrons. Whereas other constituents of the lunar atmosphere continually escape into space, water molecules created chemically by solar wind chiefly sublimate into the cold spots of permanent shadow where lunar glaciers up to 100 meters equivalent thickness may have accumulated over the ages. (auth)

26050 THE POTENTIAL OF A METAL SPHERE IN INTERPLANETARY SPACE. P. G. Kurt and V. I. Moroz. Planetary and Space Sci., 9: 259-68(May 1962).

The electrostatic potential is calculated by setting the total current to the sphere equal to zero. The currents considered are those arising from the electron and proton components of the interplanetary plasma, the electron and proton components of the radiation belts, the photoelectric effect, and the secondary emission effects. Assuming probable values for the conditions in space, it is found that during the illuminated sector of the flight, the potential must be between −2.5 and +4 v. The effects of magnetic fields and of container motion are found to be negligible (around 1 or 2 v), as a result of the indeterminacy of the original result. Under specified conditions, the sphere's potential may be as high as −25 v. (T.F.H.)

26051 COSMIC MAGNETOHYDRODYNAMICS. J. Kleczek (Pokroky mat., fys. a astron., No. 3, 293-307(1960).

The basic relation between plasma and electromagnetic field is defined. The electrical conductivity of plasma is most important, and is really the basis of magnetohydrodynamics. As a conductor, plasma is acted on by the magnetic field. Other basic comments made are: waves in plasma, are analogous to sound waves, they carry electric charges, and can move in the electric field. Electromagnetic waves can also move in plasma. MHD (alfvén) waves have a low frequency. In space (ionosphere) the most prevalent material is plasma. Ultraviolet rays ionize the upper layers of the atmosphere. This is of significance for radio reception on the magnetosphere and on the ionosphere of the moon. Northern lights show that plasma is present in interplanetary space. The corona of the sun goes a long way out into space, and recent opinions state that the earth moves through the corona. With regard to the interplanetary magnetic field, the magnitude can be judged from cosmic radiations, and from comet movement (order of 10^{-4} gauss). The corpuscular movement from the sun carries magnetic fields through space to the earth. There is an electromagnetic field in every corner of the galaxy. (OTS)

Cosmic Radiation

26052 (NASA-TN-D-1139) SOLAR PROTONS. Keith W. Ogilvie (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). July 1962. 35p.

The state of experimental knowledge and the methods used to study solar protons were examined. An account is given of the results of rocket observations carried out by NASA during the November 1960 events. (auth)

26053 COSMIC RADIATION. Karel Svoboda. Acta Geophysica Polonica, 8: 346-8(1960).

Observations made in the universe concerning cosmic radiation are discussed. Cosmic radiation on its way to earth traverses an area which influences its intensity. In crossing the geomagnetic field part of the cosmic radiation is diverted. Intensity depends on latitude and partly on elevation of the observation point. Cosmic radiation is also influenced by changing air pressure. Measures of correlation of cosmic radiation and sun activity were made and discussed. Unusually large changes in radiation intensity correspond with eruptions on the sun's surface and magnetic storms. Other observations were: full-day and half-day sun periods; 27-day variations, corresponding with the sun's rotation around its axis; and one-year and probably 11-year-periods. An analysis of an anomaly in May 1958 showed that cosmic radiation which caused this variation had its origin in the sun. The location of the source of the radiation on the surface of the sun was determined. (OTS)

26054 THE APPARENT SIDEREAL AND ANTI-SIDEREAL DAILY VARIATIONS OF COSMIC RAY INTENSITY.

R. M. Jacklyn (Antarctic Division Department of External Affairs, Melbourne). Nuovo cimento, 24: 1034-65(June 16, 1962). (In English)

A theoretical treatment is outlined of the annual apparent sidereal daily variation and the anti-sidereal daily variation associated with the following phenomena: an annual linear displacement of phase of a solar daily variation; an annual linear displacement of phase of a sidereal daily variation; an annual linear change of amplitude of a solar daily variation; combined linear changes of phase and amplitude of a solar daily variation; an annual linear change of amplitude of a sidereal daily variation; a seasonal variation of amplitude of a solar daily variation; a seasonal variation of amplitude of a sidereal daily variation; a seasonal variation of phase of a solar daily variation; a seasonal variation of phase of a sidereal daily variation; and curvature associated with the 11-year cycle of intensity variation. The theory is supplemented by analyses of facsimile daily variations, suitably modulated. (auth)

26055 SOME SOURCES OF ERROR IN MEASUREMENTS OF COSMIC RAY μ-MESON SPECTRA. R. M. Bull, W. F. Nash, and B. C. Rastin (Nottingham Univ., Eng.). Nuovo cimento, 24: 1096-1101(June 16, 1962). (In English)

The systematic and random errors that are likely to occur in momentum spectrum measurements are investigated. Data are presented that indicate that uncertainty of the errors involved in measuring the magnetic deflection of particles may lead to serious errors in the measured spectrum exponent. Attention is also directed to the large random errors in the measured exponent when small numbers of events are observed. (auth)

26056 A NOTE ON THE INTERPRETATION OF JETS. K. O. Thielheim (Universität Kiel). Nuovo cimento, 24: 1102-6(June 16, 1962). (In Italian)

Experimental results on primary cosmic ray jets are discussed in terms of a phenomenological model. Agreement with the model is found in the high-energy, high-muitiplicity region. (auth)

26057 THE SPECTRAL REPRESENTATION OF THE TWO-POINT FUNCTION AND LOCAL COMMUTATIVITY. L. Lovitch and Y. Tomozawa (Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo cimento, 24: 1147-59 (June 16, 1962). (In English)

An explicit use of local commutativity is made in the derivation of a spectral representation of the vacuum expectation value of the two-point function, under the axioms of quantum field theory. This representation affords an alternative proof of the relation between spin and statistics. Confining attention to the case of spin-0 and spin-$\frac{1}{2}$ fields, it is found that: the spectral representation of the former is unchanged from that found without explicit use of local commutativity; but for the latter two further spectral functions should be added that represent parity-violating terms. Some properties of the spectral functions arising from various invariance principles such as TCP, T, C, and P invariances are discussed. (auth)

26058 ON HIGH ENERGY COSMIC PHOTONS ORIGINATING IN INTERGALACTIC SPACE. Satio Hayakawa (Nagoya Univ., Japan). Phys. Letters, 1: 234-5(June 15, 1962). (In English)

Possibilities that π^0 meson produced by interactions between intergalactic light and cosmic radiation at ultra-high energies may be a major source of the ultra-high energy photons causing the extensive cosmic showers containing few muons are discussed. (L.N.N.)

26059 DIURNAL VARIATION OF COSMIC RADIATION INTENSITY PRODUCED BY A SOLAR WIND. H. S. Ahluwalia and A. J. Dessler (Physical Research Lab., Ahmedabad, India). Planetary and Space Sci., 9: 195-210 (May 1962).

Starting from the concept that the solar magnetic field is twisted into an Archimedes spiral, which on the average rotates with the sun, it is shown that a diurnal variation in cosmic ray intensity is produced. Cosmic rays tend to be entrapped in the rotating spiral magnetic field; the guiding centers of such particles move past the earth with a velocity of several hundred km/sec. (The guiding center velocity vector is a function of the angular velocity of the sun and the velocity of the solar wind.) It is shown that relativistic effects caused by this guiding center motion can produce a diurnal variation in cosmic ray intensity. Because the amplitude and direction of maximum intensity depend on the solar wind velocity, a measurement of the diurnal variation of cosmic ray intensity allows an estimate to be made of the solar wind velocity. On the basis of cosmic radiation data, it is concluded that the solar wind velocity is usually of the order of 300 km/sec and seldom falls below 100 km/sec, even at sunspot minimum. (auth)

26060 VELOCITIES OF VERY ACTIVE AURORAL RAYS. A. Omholt (Norwegian Inst. of Cosmic Physics, Oslo and Inst. of Theoretical Astrophysics, Oslo). Planetary and Space Sci., 9: 285-6(May 1962).

Using a 70-cps pulsed photoelectric technique, the east-west speeds of rays in a very active auroral curtain are measured. Successful series of observations are made in 21 cases; of these, 14 move eastward and 7 westward. The average velocity is 24 km/sec, and the measured velocities vary from 13 to 30 km/sec, with an error up to 30%. (T.F.H.)

26061 COSMIC RAYS. D. V. Skobel'tsyn. Vestnik Akad. Nauk S.S.S.R., 32: No. 6, 15-28(June 1962). (In Russian)

A review is given on studies of the origin and properties of cosmic particles and cosmic radiation. (R.V.J.)

26062 LATERAL DISTRIBUTION OF THE INTENSITY OF ČERENKOV RADIATION FROM BROAD ATMOSPHERIC SHOWERS. V. I. Zatsepin and A. E. Chudakov. Zhur. Eksptl'. i Teoret. Fiz., 42: 1622-8(June 1962). (In Russian)

Calculations are performed on the lateral distribution of Cherenkov radiation produced in the atmosphere as the result of passage of broad atmospheric showers of cosmic rays at two observation levels. The results of the calculations are compared with data. (auth)

Criticality Studies

Refer also to abstracts 26522 and 26541.

26063 (CEA-2157) PHYSICS EXPERIMENTS IN GRAPHITE LATTICES. P. Bacher and F. Cogne (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1962. 43p.

A review is made of the various experimental methods used to determine the physics of natural uranium graphite, lattices. Integral lattice experiments reviewed include absolute and differential effective cross section measurements by activation methods and analysis of irradiated fuels and fine structure measurements. A number of experimental results are given. (auth)

26064 (RM-2917-PR) ESTIMATES OF CRITICAL DIMENSIONS OF SPHERICAL AND SLAB REACTORS.

T. W. Mullikin (RAND Corp., Santa Monica, Calif.). Jan. 1962. Contract AF49(638)-700. 29p. (AD-270639)

Under the assumptions of constant energy of neutrons and isotropy of the collision-fission process, the determination of the critical mass of spherical and slab reactors is equivalent to the determination of two of the eigenvalues of a linear integral operator T. In the theory of radiative transfer in homogeneous plane parallel atmospheres with isotropic scattering, this same operator is an important one known as the truncated Hopf operator. The theory also applies to stratified slab and spherical reactors in which the physical properties can change from stratum to stratum. This observation is developed and then applied to reactors with a homogeneous core surrounded by a homogeneous reflector. Numerical results are given for the bare homogeneous reactors. (auth)

Elementary Particles and Radiations

Refer also to abstracts 25959 and 25963.

26065 (AFCRL-975) PULSE HEATING OF MATERIALS BY HIGHLY CONCENTRATED ELECTRON BEAMS. Scientific Report No. 1. Oskar Heil and Siegfried Vogel (Eitel-McCullough, San Carlos, Calif.). Oct. 1961. Contract AF19(604)-8810. 32p. (AD-269969)

Electron bombardment provides a means of heating with high local energy concentration and definition. The object was to investigate surface explosions and structural changes of matter caused by high temperatures, large temperature gradients, and fast quenching rates connected with electron bombardment. It was intended to operate close to the absolute limits of energy concentration in electron beams. A theoretical study was made of the mechanism of electron beam focusing to determine the maximum obtainable beam compression. Results showed that for low perveance beams the compression limit is set by the laws of thermodynamics. For high perveance beams, the thermodynamic limit cannot be reached because the electric and/or magnetic fields required become technically impossible. A numerical example illustrates this. An existing high perveance electron gun with a high area convergence ratio was adapted for the planned experiments. (auth)

26066 (ARL-62-332) INVESTIGATIONS ON FIELDS. Nathan Rosen (Israel Inst. of Tech., Haifa). Jan. 15, 1962. Contract AF61(052)-02. 12p.

A survey-type description is given concerning work done in the areas of geometrodynamics, spinors, and quantum geometry for the purpose of advancing knowledge of the nature of elementary particles. Efforts in geometrodynamics are devoted to relating elementary particles in terms of geometry and topology of space-time. Spinors are associated with many elementary particles and are the basis of a proposed theory. In quantum geometry elements are not considered as points but small regions described by probability distributions which provide a framework for particles having finite extension. Calculations in general relativity theory are also discussed. (J.R.D.)

26067 (CERN-62-17) VERY ELEMENTARY THEORY OF WEAK INTERACTIONS. M. Bell (European Organization for Nuclear Research, Geneva). Notes on three lectures by J. S. Bell. May 2, 1962. 30p.

Lectures presented at the Rutherford High-Energy Lab., Harwell, May 1959.

Notes are presented from lectures on Dirac equation, starting with the de Broglie wave, and particle interactions including discussions of Lorentz invariance, and parity. A discussion is also included concerning principles known as the V-A combination. (J.R.D.)

26068 (JINR-D-965) IZUCHENIE ROZHDENIYA $\Lambda K^0 - I\ K^0K$-PAR V π^-P VZAIMODEISTVIYAKH PRI IMPUL'SE π^- MEZONA 7-8 Bev/S. (Production of ΛK^0 and K^0K^0 Pairs in π^-P Interactions at π^- Meson Energies of 7 to 8 Bev). Wang Yung-ch'ang, V. I. Veksler, Tu Yuan ts'ai, E. N. Kladnitskaya, A. A. Kuznetsov, A. Mikhul, Nguyen Ting t'i, V. N. Penev, E. S. Sokolova, and M. I. Solov'ev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 16p.

Production of Λ-K^0 and K^0-$\bar{K}^0$ pairs in π^--p interactions at 7 to 8 Bev was studied using a 24-l propane chamber. The angular and energy characteristics of Λ, K^0, and π^Λ in the center-of-mass system were found. Data are also included on Q for Λ-K^0 and K^0-$\bar{K}^0$ pairs. (tr-auth)

26069 (JINR-E-943) THE ASYMPTOTIC BEHAVIOUR OF THE SOLUTION OF MANDELSTAM'S EQUATIONS FOR PION-PION SCATTERING. P. Suranyi (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 10p.

Possible asymptotic forms of the scattering amplitude at very high energies are shown. One type of solution cannot give a constant total cross section, the second type of asymptotic behavior is expressed as $As(s,t) \approx f(t)s^{\alpha(t)}$, if $S \to \infty$. (auth)

26070 (JINR-E-991) REGGE-POLES AND ELASTIC SCATTERING AT HIGH ENERGIES. G. Domokos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 10p.

Some consequences of an asymptote of the Regge-type on high energy elastic scattering were investigated. Relations between total cross sections of various processes were obtained. It is shown that the imaginary part of the vacuum pole is a positive definite function. An approximate analytic expression was derived for the vacuum trajectory. (auth)

26071 (JINR-P-817) UPRUGIE VZAIMODEISTVIYA CHASTITS PRI BOL'SHIKH ENERGIYAKH. (Elastic Interactions of Particles at High Energies). V. S. Barashenkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1961. 117p.

Experimental and theoretical data on cross sections of elementary particle interactions were previously analyzed considering the integral magnitudes $\sigma_{in.}$, σ_{el}, and σ_t summed according to angular distribution and all possible reactions $\sigma_t = \sigma_{el} + \sigma_{in}$; $\sigma_{in.} = \Sigma_j \sigma^j_{in.}$; $\sigma_{el} = \int \sigma_{el}(\theta)\, d\Omega$. An analysis of partial cross sections of $\sigma^j_{in.}$ and angular distributions of elastic scattering $\sigma_{el}(\theta)$ provides data on the intrinsic structure of particles. A study is made of experimental and theoretical data on elastic scattering of π and κ mesons, nucleons, and antinucleons. The analysis is limited to scatterings at high energies (T = 1 Bev) where the length of deBroglie waves are 4 to 5 times shorter than the characteristic nucleon meson cloud $\hbar/\mu c = 1.4 \times 10^{-13}$ cm. The results obtained with counters show less error than those obtained with chambers and photoemulsions. Renormalized data show that at increased energy elastic scattering concentrates at smaller and smaller angles, producing a typical diffraction picture of scattering for nucleons and other particles. (R.V.J.)

26072 (JINR-P-891) REGULYARIZATSIYA URAVNENIYA TIPA CHU-LOU DLYA PROTSESSA $\pi + N \to 2\pi + N$. (Regularization of Equations of the Chu-Low Type for

the $\pi + N \rightarrow 2\pi + N$). Kim Ch'ieh P'eng (Kim Ze Pheng) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 25p.

The regularization of a system of singular integral equations describing the process $\pi + N \rightarrow n\pi + N$ was carried out by the method similar to that suggested by N. I. Muskhelishvili. The latter method is supplemented in the case when a certain determinant vanishes. As a result of the regularization, the system of singular integral equations reduces to the Fredgolm's equation system the solutions of which are well developed. (auth)

26073 (JINR-P-904) O NENABLYUDAEMOĬ OBLASTI V DISPERSIONNYKH SOOTNOSHENIYAKH DLYA FOTOROZHDENIYA. (On the Unobserved Regions in Photo Production Dispersion Ratios). N. V. Deminа, V. L. Evteev, V. A. Kovalenko, L. D. Solov'ev, and Ch'en Ts'u-mo (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 15p.

It is shown that the continuation of the dispersion relations for the photoproduction to the non-observable region by expanding in Legendre polynomials does not lead to the discrepancy with the experimental data on the photoproduction of the neutral pions and yields the results close in the low energy region to those obtained by the differential method. The contribution from the non-observable region is calculated in the static approximation. It is also shown that in the calculation of the partial amplitudes by integrating over angles this contribution is essential at energies higher than the resonance one. (auth)

26074 (JINR-P-905) OPREDELENIE AMPLITUD ROZHDENIYA π MEZONA NA NUKLONE OT NEITRINO S POMOSHCH'YU DISPERSIONNYKH SOOTNOSHENII. (On the Application of Dispersion Relations in Determining the Amplitudes of π-Meson Production from Neutrino by Nucleon). Nguen Van-hiew (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 16p.

The amplitudes of π-meson production in neutrino-nucleon interactions are analyzed, and one-dimensional dispersion relations for the amplitudes are derived. Solutions for integral equations are developed assuming a prevailing resonance p-wave and neglecting other wave contributions to the simulated amplitude regions. (tr-auth)

26075 (JINR-P-911) O REAKTSII T + T → He^4 + 2n. (On the T + T → He^4 + 2n Reaction). Li Wang-seng, I. N. Mikhailov, and Yu. I. Fenin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1962. 8p.

An analysis was made of published data on cross sections for T + T → He^4 + 2n at 1.9 Mev. The analysis was based on the separation of channels with considerable neutron finite-state interaction. It is shown that at maximum α energy the p-wave in interacting tritons is the principal contributor to the reaction. (tr-auth)

26076 (JINR-P-938) VLIYANIE $\pi\pi$-VZAIMODEISTVIYA NA S-i p-VOLNY π-N RASSEYANIYA. (Effects of π-π Interaction on S- and p-Waves in π-N Scattering). P. S. Isaev and V. A. Meshcheryakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 21p.

Double Mandelstam expressions are applied for describing π-N scattering partial waves, assuming strong π-π resonance interaction in the p-state (T = 1). $\nu = \vec{q}^2$ and C = cos θ, where θ is the angle of scattering in first reaction, were selected as variables. (R.V.J.)

26077 (JINR-P-949) OB ODNOĬ KRAEVOĬ ZADACHE DISPERSIONNYKH SOOTNOSHENĬ. (On an Edge Problem in Dispersion Ratios). P. Kh. Byrnev, V. A. Meshcheryakov, and I. P. Nedyalkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 11p.

An attempt was made to determine the lower partial waves in elastic low-energy π-π and π-n scattering by reducing the problem to a system of algebraic equations formulated in a unique edge problem. (R.V.J.)

26078 (JINR-P-960) O NEKOTORYKH SVOISTVAKH PAR K^0K^0-MEZONOV. (On Certain Properties of K^0K^0 Meson Pairs). V. I. Ogievetskii, E. O. Okonov, and M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics and Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 14p.

A problem is considered as to how the behavior of the $K^0-\bar{K}^0$ systems depends upon whether the orbital angular momentum is even or odd. (auth)

26079 (JINR-P-964) ZAMECHANIE O NEPERENORMIRUEMYKH TEORIYAKH. (Remarks on Non-renormalization Theories). B. M. Barbashov and G. V. Efimov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 6p.

It is shown that the procedure of the analytic extension over the coupling constant g^2, which was previously suggested for removing the ultraviolet divergences in the unrenormalized theories, leads to the complex values of the observable quantities. (auth)

26080 (JINR-P-972) POISKI ANOMALII PRI RASPADE μ^- MEZONOV V PARAMAGNITNYKH METALLAKH. (Search for Anomalies in μ^- Meson Decay in Paramagnetic Metals). L. B. Egorov, A. E. Ignatenko, A. V. Kuptsov, and M. G. Petrashku (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 6p.

Relative electron yields from μ^- mesons in the mesic atoms of palladium, titanium, and their hydrides were measured with scintillation counters. The results indicate the absence of the effects due to uncoupled electrons of the atoms which lead to an increase in the μ meson decay probability in the mesic atoms of the transition metals of the iron group, as well as to the displacement of the levels of the x rays emitted in 2p-1s-transitions. (auth)

26081 (JINR-P-974) SVOISTVA π^0-MEZONOV OBRAZUYUSHCHIKHSYA V NEUPUEGIKH STOLKNOVENIYAKH π-MEZONOV S NUKLONAMI PRI ENERGII 7 Bev. (Properties of π^0-Mesons Formed in Inelastic Collisions of π^- Mesons with Nucleons at 7 Bev Energy). V. B. Lyubimov, A. V. Nikitin, and Z. Trka (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 8p.

Inelastic π^--N interactions accompanied by γ quanta were selected. It was assumed that all γ quanta were produced in the decays of π^0 generated in these interactions. The average number of π^0 was found for the events with different multiplicity of charged particles. The data concerning the energy characteristics of π^0 and their angular distributions were obtained. (auth)

26082 (JINR-P-981) UGLOVYE RASPREDELENIYA π-MESONOV OBRAZOVANNYKH V NUKLONNYUKH SOUDARE NIYAKH I GIPOTEZA IZOTOPICHESKOI INVARIANTNOSTI. (Angular Distributions of π Mesons Produced in Nucleon Interactions and the Hypothesis of Isotopic Invariability). Lü Min and Yu. D. Prokoshkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 10p.

The angular distribution of π^0 mesons produced in neutron-proton collisions was measured at about 600 Mev.

It is compared with pion distributions found earlier to check the isotopic invariance hypothesis. (auth)

26083 (JINR-P-1000) O SVYAZI MEZHDU AMPLITUDAMI PROTSESSA $K\bar{K} \rightarrow \pi\pi$ I SPEKTRAMI K_{e4} RASPADA. (On the Bond Between the Amplitudes of $K\bar{K} \rightarrow \pi\pi$ Process and K_{e4} Decay Spectra). Nguyen Van-hieu (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 3p.

It is shown that the spectra of the K_{e4}-decay ($K \rightarrow e + \nu + \pi + \pi$) with respect to the two-pion effective mass are defined by the $K_{\mu 2}$-decay effective constant and the $K + \bar{K} \rightarrow \pi + \pi$ partial amplitudes with $\lambda = 0.1$ if the strangeness nonconserving axial current is partially conserved. Thus, the K_{e4}-decays date might give information about low energy $K\pi$- and $\pi\pi$- interactions. (auth)

26084 (NP-11623) MULTINUCLEON CAPTURE OF K^- MESONS AND SOME ASSOCIATED PROBLEMS OF THE K^- CAPTURE PROCESS (thesis). Technical Report No. 26. George Thomas Condo (Illinois. Univ., Urbana). Mar. 1962. Contract ONR 1834(05). 101p.

The problem of the multinucleon absorption of K^- mesons was studied by searching for fast $\Sigma^{\pm}$ hyperons emitted from K^- capture stars in normal and in water-soaked Ilford G5 nuclear emulsion. These fast ($\gtrsim 60$ mev) hyperons are the only certain indication that a K^- meson is absorbed nonmesonically. Previous experiments conflicted on the question of the variation of the nonmesonic K^- absorption frequency with the mass of the capturing nucleus. On the basis of the data obtained and their reasonable similarity with that of Evans et al., it was concluded that the capture of K^- mesons by the light emulsion nuclei (C,N,O) is 2.2 ± 0.3 more likely to yield a fast hyperon than is K^- capture by Ag and Br. Combining this with the hyperon absorption probabilities deduced from a study of Auger electron emission, it was found that the multinucleon K^- absorption probability is approximately the same for light and heavy capturing nuclei in nuclear emulsion (excluding hydrogen). Of the 56 fast hyperon events, 17 were shown to be consistent with K^- capture by a light nucleus. This was deduced by application of the principles of energy, momentum, and charge conservation to the K^- capture event. By combining these events with those reported by Evans et al., it was found that when a K^- meson is absorbed through a multinucleon channel by C^{12} and O^{16}, the basic interaction in 92% of the events is consistent with the destruction of a single α particle subunit. Examination of the neutron and proton spectra resulting from these completely analyzable light nucleus events showed that when the K^- interacts with an α particle substructure of these light nuclei, there is no strongly preferential absorption on an n-p pair. That is, for these events, there is no evidence that the reaction channel $K^- + n + n \rightarrow \Sigma^- + n$ is suppressed. The Auger spectrum resulting from capture and subsequent cascade of K^- mesons showed evidence for the line structure predicted by conventional theory. However, a large number of electrons which were not associated with a theoretical atomic transition suggested the possibility of an alternative mechanism being operative. From the presence of a significant fraction of electrons of energies >150 kev this process was interpreted as one proposed by Mann and Rose, whereby the capture occurs directly from the continuum to low lying states with the ejection of a single high energy electron. By comparing the frequency of ejection of Auger electrons in those K^- capture events which produce charged hyperons with those which do not, the charged hyperon absorption probabilities in heavy and light nuclei were approximately determined. For light nuclei, the observed value of this quantity was 0.29 while for heavy it was 0.62. (auth)

26085 (NP-11632) O RESHENII LINEINYKH URANENII DISPERSIONNOGO METODA V DVUKHCHASTICHNOM PRIBLIZHENII. (Solving the Linear Equations of the Dispersion Method with a Two Particle Approximation). A. F. Grashin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 24p.

A method is suggested for solving the linear integral equations in the calculation of nearest singularities by dispersion techniques (two-meson approximation). It is shown that there can be only one solution that at low energies does not depend on the amplitude behavior in the infinity determined by remote singularities (or by heavier unitary mass). The independence from the behavior at high energies is equivalent to the requirements of stability to infinite perturbations, is a necessary condition in the given problem, and secures simultaneous unitary solutions. The previous diversified manifestation was due to supplementary solutions unstable to infinite perturbations which do not suit the given problem. Calculation methods for π-π interactions suggested by W. R. Frazer and J. R. Fulco and by J. Bowcock are based on unstable solutions and in general cases give erroneous results. A detailed analysis is offered for the amplitude of π-meson electromagnetic form factors. (tr-auth)

26086 (NP-11737) TRANSVERSE POLARIZATION OF CONVERSION ELECTRONS FOLLOWING BETA DECAY. B. Blake, R. Bobone, H. Frauenfelder, and H. J. Lipkin (Illinois. Univ., Urbana). [1960]. 8p.

Measurements on polarization of electrons in beta decays observed in coincidence with the preceding beta particles are presented for I^{131}, Ce^{141}, Ce^{144}, Tm^{170}, Au^{198}, Au^{199}, Hg^{203}, and Pa^{233}. (J.R.D.)

26087 (NP-11780) THE CORRESPONDENCE PRINCIPLE. [PART] I. Izuru Fujiwara. 1962. 32p.

Presented at Proceedings of the Physics Seminar in Trondheim No. 3—1962.

Information contained in notes from a seminar on the functional integral methods is presented. Included are discussions and derivations concerning the elementary quantum mechanics associated with particles and fields. (J.R.D.)

26088 (NP-11781) A STUDY IN KEMMER-ALGEBRA AND FOLDY-WOUTHUYSEN TRANSFORMATIONS FOR PARTICLES WITH SPIN 0 AND 1. H. Hoegasen (Norges Tekniske Högskole, Trondheim). [1962]. 62p.

A review of Kemmer Algebra for particles with spin 0 and 1 is presented. It is shown that the transformation to the Foldy-Wouthuysen representation can be performed by an Eriksen type of trasformation. Wave equations and transformed wave equations are presented. (M.C.G.)

26089 (NP-11832) O DIFFRAKTSIONNOM OBRAZOVANII CHASTITS PRI VYSOKIKH ENERGIYAKH. (Diffraction Formation of Particles at High Energies). E. D. Zhizhin (Akademiya Nauk S.S.S.R. Institut Atomnoĭ Energii. Moskovskiĭ Inzhenerno-Fizicheskii Institut) and Yu. P. Nikitin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 25p.

A black-sphere nuclear model was used for calculating differential and total cross sections of diffraction production of π mesons and strange particles in fast-proton interactions with nuclei and diffraction production of nucleon-antinucleon pairs in fast π-meson collisions with nuclei. Correlations of differential cross sections for diffraction processes with experimental data provide data on the behavior of form factors describing the πNN, $K\Lambda N$, and $K\Sigma N$

vertex and data for determining the K or λ (or Σ) relative parity. (tr-auth)

26090 (NYO-10233) THE STUDY OF SPURIOUS SCATTERING IN NUCLEAR EMULSIONS AND THE EFFECT OF HIGHER ORDER DIFFERENCES IN SCATTERING MEASUREMENTS. P. J. Lavakare and E. C. G. Sudarshan (Rochester, N. Y. Univ.). May 21, 1962. Contract AT (30-1)-875. 29p.

By considering the higher order differences in the scattering measurement, an approach for reducing the spurious scattering in nuclear emulsions is discussed. The possible effect of turbulence during the developing stage is discussed. (auth)

26091 (NYO-10234) ON HYPERON-NUCLEON SCATTERING. G. Dullemond (Rochester, N. Y. Univ.) and J. J. de Swart (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). May 1, 1962. Contract AT(30-1)-875. 20p.

Different nucleon-nucleon potential models are used for the construction of hyperon-nucleon potential models and the predicted cross sections are compared. It is shown that the experimental Λ-N elastic cross sections are in agreement with global symmetry ($g_{NN} = g_{\Sigma\Sigma} = g_{\Lambda\Sigma}$) but not with anti-global symmetry ($g_{NN} = -g_{\Sigma\Sigma} = -g_{\Lambda\Sigma}$). (auth)

26092 (TID-16031) STUDIES OF H_2^+ DISSOCIATION. PHASE II. Quarterly Progress Report No. 2, February 15, 1962–May 14, 1962. A. W. Ehler (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). June 6, 1962. Contract AT(04-3)-362. 6p.

The trajectory of the primary H_2^+ ion beam from the point of its entry into the analyzing chamber to the wire which produces an intense dissociating electric field was investigated by placing paper strips along successive points of the trajectory. A dark spot burned into the paper marked the point at which the ions impinged onto it. In this manner, it was confirmed that the primary H_2^+ ion beam was directed normally onto the dissociation wire. Improved baffles were placed in the analyzing chamber to minimize the background due to scattered ions and secondary electrons. Various interpretations of the origin of the image attributed to the H^+ ions are given. (M.C.G.)

26093 (UCRL-10252) SCATTERING OF NEGATIVE PIONS ON PROTONS AT 310 Mev: DIFFERENTIAL AND TOTAL CROSS-SECTION AND PHASE-SHIFT ANALYSIS (thesis). Hugo R. Rugge (California. Univ., Berkeley. Lawrence Radiation Lab.). May 20, 1962. Contract W-7405-eng-48. 91p.

The differential cross section in π^--p elastic scattering at 310 Mev incident-pion energy was measured for 28 angles in the angular region $25° \leq \theta_{lab} \leq 160°$. The reaction was observed by counting the scattered pions emerging from a liquid hydrogen target with a counter telescope consisting of scintillation and Cherenkov counters. A measurement of the total cross section by attenuation as a function of cutoff angle was also performed, using scintillation counters. These data were incorporated with polarization and other differential cross section data at this energy, and a phase shift analysis was performed. An IBM 7090 search program was developed for this purpose. Analysis of all data for spd waves (up to $\ell = 2$) has resulted in a single acceptable solution that has I-spin $^3/_2$ phase shifts in excellent agreement with results of a previous π^+-p phase shift analysis, and has I-spin $^1/_2$ phase shifts that are <6° for the $D^{1/2}$ shift which is ≈15°. Errors on the phase shifts vary from 0.4 through 1.1° An extension of the analysis to spdf waves (up to $\ell = 3$) results in two probable solutions, and one that is rather unlikely. These, as well as the spd solution, are discussed. Errors on the spdf solution are larger, ranging up to 2°. (auth)

26094 A SET OF INTEGRAL EQUATIONS FOR THE PHOTOPRODUCTION AMPLITUDES OF PIONS ON NUCLEONS. [PART] II. G. Białkowski and A. Jurewicz (Univ. of Warsaw). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 10: 165-9(1962). (In English)

Integral equations for multipole amplitudes are derived from previous equations. (G. Białkowski and A. Jurewicz, Bull. Acad. Polon. Sci., Ser. Sci., Math., Ast., and Phys., 10: 49(1962)). (auth)

26095 g MINUS TWO. THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. CERN Courier, 2: No. 4, 3-7 (Apr. 1962). (In English)

Considering the muon as a simple Dirac particle, the anomalous magnetic moment was calculated from quantum electrodynamics. It is indicated that the muon is best regarded as a "heavy electron" and that there is no breakdown of quantum electrodynamics down to about 10^{-14} cm nuclear size. The mass of the muon is 206.768 ± 0.003 times the mass of the electron. (L.N.N.)

26096 ON MESON EMISSION IN ANALOGY WITH ČERENKOV RADIATION. P. Smrž (Inst. of Physics, Czechoslovak Academy of Science, Prague). Czechslov. J. Phys., 12: 169-76(1962). (In English)

An analogy with electromagnetic Cherenkov radiation was used for the description of multiple meson production. It is shown that some properties of the Cherenkov radiation applied to multiple meson production appear to be specific for the electromagnet field only and should not be used in the meson theory without certain modifications. The form of the energy spectrum and of the angular distribution is derived. The influence of the space dependence of the refractive index on the energy spectrum is discussed. (auth)

26097 MULTIPLE CREATION OF NUCLEON PAIRS BY ENERGETIC PHOTONS IN AN OPEN COSMOLOGICAL MODEL. D. A. Frank-Kamenetskii. Doklady Akad. Nauk S.S.S.R., 144: 307-9(May 11, 1962). (In Russian)

Nucleon pairs can be created by the reaction: $2\gamma \rightleftharpoons N + N^1$. The probability of nucleon formation per unit time in a volume V is given by: $W_1 = \sigma[n][n^2]\, vV$ where $\sigma = 3 \times 10^{-30}$ c/v cm^2, [n] and [n^2] are the equilibrium concentrations of nucleons and antinucleons, and v is the relative velocity. If ξ is the total energy of the nucleon having a momentum p, then the equilibrium concentrations of the nucleons are: $[n] = [n^2] = \lambda_T^{-3} \exp(-\xi_0/kT)$, where $\lambda_T = {}^+h/mv$ is the wavelength of the nucleon at an average velocity $\bar{v} \approx \sqrt{kT/m}$. At moderate gravitational fields it can be estimated that $\xi = m(c^2 + \Phi)$, where Φ is the gravitational potential. The probability for the formation of N succeeding pairs after the formation of the first pair of nucleons is examined for a large volume V. If the time and distance sides are great enough, fluctuations occur in which aggregates of nucleons ("worlds and anti-worlds") exist along with the creation and annihilation of nucleons in the universe. (TTT)

26098 RADIATION CORRECTIONS FOR THE INTENSITY OF CHERENKOV EMISSION OF CHARGED PARTICLES. V. N. Tsytovich (Lebedev Inst. of Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 310-13(May 11, 1962). (In Russian)

The classic theory of Cherenkov radiation describes the macroscopic energy loss of a charged particle by an e^2 term. The quantum corrections are small, and have a relative order of ω/ξ_0, where ω is the frequency of the emitted quantum and ξ_0 is the energy of the particle. Terms in e^4 and e^4 ln e^2 are taken into account to determine the radia-

tion correction to the energy loss of the particle. The effective energy spectrum E = E(p) is determined from the equation: $E - \xi_p - \Sigma(E,p) = 0$. The imaginary part of E describes the energy losses of the particle. E is the particle energy; $\xi_p = \sqrt{p^2 + m^2}$ is the energy of the free particle; $\Sigma(E,p)$ is the mass operator determined by the usual graphical method according to selection rules; p is the momentum of the particle. At non-relativistic velocities ($v \ll 1$) the radiation losses are small. For relativistic velocities the radiation correction is noticeable at $\xi_p/m > 10^3$. The radiation loss is 5 to 7% of the ionization loss. (TTT)

26099 ABOUT THE STRANGENESS OF LEPTONS. W. Królikowski (Inst. for Advanced Study, Princeton, N. J.). Nuclear Phys., 33: 261-71(May 1962). (In English)

Two versions of the universal Fermi interaction are compared. The first is the current-current interaction. The second satisfies the over-all rule $|\Delta S| = 1$ (S is the total strangeness of leptons, baryons, and mesons). In the second interaction, pairing of leptons depends, owing to the $|\Delta S| = 1$ rule, on the relative strangeness of the other pair of particles coupled to those leptons. This second interaction cannot be transmitted by an intermediate vector field. In both cases leptonic Λ-decay rates are diminished compared to the Gell-Mann-Feynman theory. In the second case these rates may easily be reduced to $\frac{1}{10}$ of the original values. If the second interaction were valid, the rule $|\Delta S| = 1$ would be a general property of both leptonic and non-leptonic weak processes. No progress, however, is achieved by using this interaction towards explaining non-leptonic weak processes in terms of the universal Fermi interaction. A Fermi interaction consistent with the isobar and parity properties of non-leptonic hyperon decays is given. (auth)

26100 FOURTH ORDER SPECTRAL FUNCTIONS FOR THE ELECTRON PROPAGATOR. Afaf Sabry (Univ. of Lund). Nuclear Phys., 33: 401-30(May 1962). (In English)

Källén's formal treatment of quantum electrodynamics without the aid of perturbation theory is applied to a fourth order computation of the complete one-electron propagator. (auth)

26101 POLARIZATION IN NEUTRON-DEUTERON ELASTIC SCATTERING BELOW 1.0 Mev. A. T. G. Ferguson and R. E. White (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 33: 477-81 (May 1962). (In English)

The polarization of neutrons scattered through 80° ± 15° (c.m.) by deuterons is measured from 0.5 to 1.0 Mev. The observed polarizations are positive and between 5 and 15%, and are in agreement with predictions for this energy region. (auth)

26102 THE NEUTRON-DEUTERON POLARIZATION BELOW 2 Mev. L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nuclear Phys., 33: 482-4(May 1962). (In English)

A prediction of the neutron-deuteron polarization, in error by a sign due to a mistake in the formalism, is corrected. The corrected prediction is in agreement with experiment, and the significance of this agreement is discussed. (auth)

26103 K^* AND THE K_{l3} DECAY MODE. S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 35: 508-10(June 1962). (In English)

It is shown that the K_{l3} decay mode (l = lepton) is dominated by a K^* pole. The vector coupling hypothesis is supported. (auth)

26104 PHENOMENOLOGICAL TREATMENT OF PION-PION PRODUCTION. C. Marish (Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 35: 511-28(June 1962). (In English)

Experimental data on the pion production in pion-proton collisions in the energy region from the meson production threshold to 1.5 Bev are discussed. Up to a total energy of two pions in their center-of-mass system equal to 400 Mev, the interactions of two pions in the states with isobaric spins $T_{\pi\pi} = 0$ and $T_{\pi\pi} = 2$ predominate, the state with $T_{\pi\pi} = 0$ being the more probable one. At higher energies all states contribute, but the contribution of each of them varies with energy. The two maxima in the cross section for the production of charged particles by pions, with energies of about 600 and 900 Mev in the laboratory system, can be explained by the model of interaction of two pions with isobaric spin $T_{\pi\pi} = 1$, and the third maximum with the pion energy of 1370 Mev by the same with isobaric spin $T_{\pi\pi} = 2$. One of the experiments under discussion proves to be sensitive to the properties of the isobaric model for pion-pion production. (auth)

26105 A DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT FROM n-p SCATTERING AT 350 Mev. A. Ashmore (Univ. of Liverpool), W. H. Range, R. T. Taylor, B. M. Townes, L. Castillejo, and R. F. Peierls. Nuclear Phys., 36: 258-83(July 1962). (In English)

The n-p angular distribution near the backward direction was measured by counting recoil protons from a liquid hydrogen target. Data were obtained at 114 to 174° center-of-mass, with an error ≈ 1.4%. The angular distribution was fitted by using backward and forward single pion exchange poles plus a polynomial. Data were used to establish the absolute scale of the differential cross sections with an error appreciably smaller than the fitting error. The effects on the analysis of excluding certain points, varying the meson mass, using an alternative analytical form, and including possible two-pion poles were investigated. The contribution from the 1-π exchange pole is definitely established, at about g^2. (auth)

26106 DEPENDENCE OF THE CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG ON ELECTRIC AND MAGNETIC FIELDS. A. Bisi, A. Cattoni, A. Fasana, and L. Zappa (Istituto di Fisica del Politecnico, Milan). Nuclear Phys., 36: 320-7(July 1962). (In English)

The degree of circular polarization of external bremsstrahlung (EB) was measured as a function of static magnetic and electric fields. Sources of Y^{90} and P^{32} were used; Ag and PbO were selected for targets. The degree of EB circular polarization does not depend on the field when the magnetic field effect points backward to the momentum of the radiating electron beam. It decreases with increasing field when the effect points forward to the momentum. The dependence on the field was investigated up to 20000 G when a decrease of about 35% was attained and found to be different in the two targets. The degree of EB circular polarization in PbO decreases with increasing electric field, but no difference was observed between forward and backward field direction. A polarization decrease of about 15% was attained at 20 kv cm^{-1}. Observed phenomena cannot be attributed to any spurious effects of instrumental nature. (auth)

26107 MASS SPECTRUM FROM FOUR-BOSON CONTACT INTERACTION. Bibhuti B. Deo (Ravenshaw Coll., Cuttack, India). Nuclear Phys., 36: 328-33(July 1962). (In English)

Following the analysis of Nambu for four-fermion inter-

actions, an attempt is made to explore the possibility of a mass spectrum for a self-coupled charged scalar or pseudoscalar boson (spin zero) field. There can be a bound state of zero mass only if the vertex function is momentum dependent. Assuming the existence of this particle, the strength of its coupling is determined. All couplings are "strong," but finite. The two-meson scattering cross section exhibits a maximum. The possibility of existence of a bound vector meson is discussed. (auth)

26108 CHARACTERISTICS OF A C^{14} SOURCE AND A VERSATILE THICKNESS GAGE. G. Missiroli and U. Valdrè (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 22: Suppl. No. 2, 590-602(1961). (In Italian)

The laws describing the absorption and backscattering of β rays from radioactive sources are reviewed as an introduction to a discussion of the characteristics of C-14 sources. The design and operating characteristics of a thickness gage using C-14 and the contrast filters are described. (J.S.R.)

26109 SEARCH FOR A ROTATIONAL SYMMETRY OF THE UNIVERSAL FERMI INTERACTION. W. Królikowski (Inst. of Advanced Study, Princeton, N. J.). Nuovo cimento, 24: 969-79(June 16, 1962). (In English)

It is shown that the unwanted leptonic weak processes can be avoided by assuming for the universal Fermi interaction a rotational symmetry in a formal three-dimensional space. This so-called ("weak isospace") is different from the isospace of strong interactions as well as from the so-called M space. The conservation of the additive muonic charge is a simple consequence of the lack of a fourth dimension in this space, and is consistent with the general rule "$\Delta S/\Delta Q = 0$ or 1 and $\Delta Q = 0$ or 1" satisfied by the total weak current when the proposed symmetry holds (S = total strangeness of leptons, baryons, and mesons). No attempt is made toward explaining the rule $|\Delta T| = \frac{1}{2}$ for nonleptonic weak processes in terms of the universal Fermi interaction. (auth)

26110 PARTIAL WAVE DISPERSION RELATIONS FOR LAMBDA-NUCLEON SCATTERING. Alladi Ramakrishnan and A. P. Balachandran (Inst. of Mathematical Sciences, Madras). Nuovo cimento, 24: 980-99(June 16, 1962). (In English)

Partial-wave dispersion relations are derived for the process $\Lambda + N \rightarrow \Lambda + N$ and the associated processes $\Lambda + \bar{N} \rightarrow \Lambda + \bar{N}$ and $\Lambda + \bar{\Lambda} \rightarrow N + \bar{N}$. (auth)

26111 ON THE Y*-RESONANCES. Allari Ramakrishnan, T. K. Radha, R. Thunga, and A. P. Balachandran (Inst. of Mathematical Sciences, Madras). Nuovo cimento, 24: 1006-12(June 16, 1962). (In English)

On the assumption that the Λ-π and Σ-π resonances are in the S-wave, $J = \frac{1}{2}$ state, effective range formulae are derived for the Λ-π and Σ-π scattering amplitudes in this state using a static approximation. (auth)

26112 THE PHASES OF THE PROTON'S ELECTROMAGNETIC FORM FACTORS IN THE TIME-LIKE REGION. P. G. O. Freund (Geneva Univ.) and W. Kummer. Nuovo cimento, 24: 1160-4(June 16, 1962). (In English)

It is shown that from the electromagnetic form factors of the proton in the space-like region and the measurement of the differential cross section of the process $p + \bar{p} \rightarrow e + \bar{e}$, information can be obtained concerning both the moduli and phases of form factors for all time-like arguments, including the unphysical region. (auth)

26113 RADIATIVE DISINTEGRATION OF PIONS. J. P. Adam (Laboratoire de Physique Atomique et Moléculaire, Collège de France, Paris). Nuovo cimento, 24: 1165-9(June 16, 1962). (In French)

The photon spectrum produced in the decay of charged π mesons is calculated theoretically. It is assumed that the decay is able to proceed through an intermediate baryon-antibaryon (nucleon-antinucleon) state, and that photons corresponding to the population and depopulation of this state should be observable. A method for renormalizing the Feynman graph contributions, combined with the use of principle of gauge invariance, allows the spectrum to be calculated without the need of introducing a cut to account for the nucleon-antinucleon pair. The global matrix element calculated for this spectrum is thus finite. It is found that internal bremsstrahlung is the dominant process from the physical viewpoint. (T.F.H.)

26114 ON THE ρ-PARTICLE CONTRIBUTION TO PION-NUCLEON SCATTERING. Y. S. Liu and A-u-Zaman (Imperial Coll., London). Nuovo cimento, 24: 1170-3 (June 16, 1962). (In English)

It is concluded that in the reactions $\pi^- + p \rightarrow p$ (or n) + π^- + π^0 (or π^+), it is possible that peripheral collisions of the form $\pi^- + p \rightarrow p$ (or n) + ρ^0 (or ρ^+) followed by decays $\rho \rightarrow 2\pi$ may give large contributions. It is further concluded that the π^--p elastic scattering near threshold may contain a large contribution from exchange of a ρ meson. It is noted that the processes described are dominant contributions at most, and are definitely mitigated by competing reactions. (T.F.H.)

26115 A NEW MEASUREMENT OF THE ANOMALOUS MAGNETIC MOMENT OF THE MUON. G. Charpak, F. J. M. Farley, R. L. Garwin, T. Muller, J. C. Sens, and A. Zichichi (CERN, Geneva). Phys. Letters, 1: 16-20(Apr. 1, 1962). (In English)

By analysis of the precession of polarized μ mesons in a 16-kOe magnetic field, the anomalous magnetic moment of the μ meson is measured as $(1162 \pm 5) \times 10^{-6}$. The results, within 5 parts in 10^3, also yield that the μ charge (q_μ) is equal to the electron charge (q_e) and that the charge of the ν_μ equals zero. The results are used to calculate the μ mass as $(206.768 \pm 0.003)m_e$. (T.F.H.)

26116 ASYMPTOTIC PROPERTIES OF SCATTERING AND MULTIPLE PRODUCTION. D. Amati, S. Fubini, and A. Stanghellini (CERN, Geneva). Phys. Letters, 1: 29-32 (Apr. 1, 1962). (In English)

A model for elastic and inelastic processes in interactions above the Bev region is considered; the model consists of a superposition of peripheral diagrams, and represents an approximate solution of the strip approach to the Mandelstam representation. The asymptotic behavior of cross sections, multiplicities, secondaries, and elastic amplitudes in the model is reviewed. Cuts in the angular momentum appear in the model, and their effects are also discussed. (T.F.H.)

26117 POSSIBLE EXISTENCE OF A PION-PION RESONANCE IN THE s-WAVE I = 2 ISOPIN STATE. N. N. Biswas (Max-Planck-Institut für Physik und Astrophysik, Munich). Phys. Letters, 1: 193-4(June 15, 1962). (In English)

The meson (K^2) decay rate into the 2π mode may be analyzed to give a small scattering length in the I = 2 state in agreement with that obtained from the π-N reaction. This leads to conjecture of an s-wave, I = 2 π-π resonance at about 500 Mev. (L.N.N.)

26118 A NATURAL EXPLANATION OF THE NARROW PION-PION RESONANCE. V. V. Serebryakov and D. V. Shirkov (Inst. for Mathematics, Siberian Div., Academy of

Sciences, Novosibirsk, USSR). Phys. Letters, 1: 195-6 (June 15, 1962). (In English)

Resonant branches of π-π solutions obtained using the δ approximation valid at small values of the interaction constant λ are extended into the domain in which λ is not small, using electronic-computer calculations. Features and physical content of the solutions are discussed. (L.N.N.)

26119 ON A LOCALISED GROUP MODEL FOR N-ELECTRON SYSTEMS. E. Kapuy (Research Group for Theoretical Physics, Hungarian Academy of Sciences, Budapest). Phys. Letters, 1: 205-6(June 15, 1962). (In English)

An antisymmetric wave function approximation for a system of electrons consisting of loosely-coupled electron groups is presented. The group functions are antisymmetric, normalized, and orthogonal in the strong sense, and it is implied that they are localized to perpendicular subspaces. The ground-state energy lies below that obtained by the Hartree-Fock method and may be close to the exact non-relativistic ground-state energy if the electron groups of the real system are strongly localized to different regions of space. (L.N.N.)

26120 π^+-P ELASTIC SCATTERING AT 820, 900 AND 1050 Mev. R. Barloutaud, C. Choquet-Louedec, A. Derem, J. Heughebaert, A. Leveque, and J. Meyer (Centre d'Études Nucléaires, Saclay, France). Phys. Letters, 1: 207-8 (June 15, 1962). (In English)

Elastic and inelastic cross sections were measured, and angular distributions in elastic interactions were determined at 820, 900, and 1050 Mev. The experiment was performed using a 35-cm hydrogen bubble chamber producing a 14700-gauss magnetic field. Calculations and data are presented in graphical and tabular forms. (L.N.N.)

26121 ON THE REACTIONS $\bar{p} + p \rightarrow K + \bar{K} + X_0$. George A. Snow (European Organization for Nuclear Research, Geneva). Phys. Letters, 1: 213-15(June 15, 1962). (In English)

The reaction $\bar{p} + p \rightarrow K + \bar{K} + X_0$ occurring at rest in hydrogen, is considered; X_0 can denote a neutral particle or narrow resonant state having definite quantum numbers for spin, parity, and charge conjugation. The relation of the quantum numbers of X_0 to the characteristics of the reaction is discussed, assuming that essentially all the p-$\bar{p}$ annihilations at rest take place from S states. (L.N.N.)

26122 DETERMINATION OF THE SLOPE OF THE POMERANCHUK-TRAJECTORY FROM HIGH ENERGY ELASTIC SCATTERING. G. Czapek, G. Kellner, and H. Pietschmann (Univ. of Vienna). Phys. Letters, 1: 226-8(June 15, 1962). (In English)

Elastic interactions of 16-Bev π^- mesons and 24-Bev protons with protons (corresponding to 5.6 and 6.9 Bev, respectively, in the cms system) were studied using bubble chamber and emulsion techniques. Elastic and total cross sections were measured. The Pomeranchuk-trajectory slope was determined; data compared favorably with the Regge-pole hypothesis. (L.N.N.)

26123 DISPERSION RELATIONS APPLIED TO π^--p SCATTERING. M. I. Ali and Haque (Dacca Univ., East Pakistan). Phys. Letters, 1: 231-3(June 15, 1962). (In English)

Dispersion amplitudes for π^--p scattering to 1.9 Bev were calculated using a subtraction method (Hong-Yee-Chiu, Phys. Rev. 110: 1140(1958)) and a modified Anderson π^--p scattering cross section curve. Results agree with data. (L.N.N.)

26124 ON A POSSIBILITY OF OBTAINING POLARIZED BEAMS OF VECTOR OR PSEUDOVECTOR MESONS. J. Werle (Inst. for Nuclear Research and Univ. of Warsaw). Phys. Letters, 1: 233-4(June 15, 1962). (In English)

Vector and pseudovector mesons denoted by X are considered. Assignment of spin, intrinsic parities, charge parities, etc., would be facilitated by performing measurements on polarized beams. Reactions such as $\pi + N \rightarrow N + X$, $K^- + N \rightarrow A + X$, $N + \bar{N} \rightarrow X + n\pi$, etc., involve particles, other than X, having nonvanishing spins. Polarizations of these remaining particles must be known if the polarization of X is to be determined. Polarized beams of X particles are obtained in reactions $0 + 0' \rightarrow 0'' + X$, where 0,0', and 0" are arbitrary particles of spin zero. (L.N.N.)

26125 CERTAIN GENERAL ORDER-DISORDER MODELS IN THE LIMIT OF LONG-RANGE INTERACTIONS. George A. Baker, Jr. (Univ. of California, San Diego, La Jolla, Calif.). Phys. Rev., 126: 2071-8(June 15, 1962).

Investigations were made in the limit as the range of the interactions becomes indefinitely great, but is still small compared to the size of the system, the behavior of a large class of order-disorder models. This class includes, for example, the Ising model, the spherical model, and the Gaussian model. When certain general conditions hold and the interparticle interaction is chosen to be the same for all models, but otherwise arbitrary, the energy per particle above the critical temperature has the same limiting value through terms of order 1/R, where R is a measure of the number of spins in the range of the interaction. The behavior above the critical point in this limit does not necessarily provide information about the behavior below the critical point. Examples are worked out which illustrate the results. (auth)

26126 NUCLEON-NUCLEON TRIPLET-EVEN POTENTIALS. Norman K. Glendenning and Gustav Kramer (Univ. of California, Berkeley). Phys. Rev., 126: 2159-68 (June 15, 1962). (UCRL-9904)

Triplet-even potentials that fit the deuteron data and yield scattering lengths falling within the range of uncertainty were found. The potentials behave at a large distance such as the one-pion exchange potential as required by meson theory. Potentials which fit the deuteron data and obey this asymptotic requirement can make a unique prediction for the deuteron D-state probability if the triplet scattering length is accurately known. The phase shifts for the potentials were calculated at 95, 210, and 310 Mev, and they fall within the range allowed by phase-shift analysis of the n-p data. The deuteron electromagnetic form factor was computed for some of the potentials, and the scalar nucleon form factor $F_1^p + F_1^n$ and neutron form factor F_1^n were deduced from elastic electron-deuteron scattering data in the momentum transfer range $q \leq 3f^{-1}$. This deduction depends, to a high degree of accuracy, only on the one-pion exchange potential tail of the potential and not on the inner region. F_1^n is zero or very small and negative. (auth)

26127 $\pi^- + p \rightarrow \pi^0 + n$ CHARGE EXCHANGE CROSS SECTIONS AT 20.7 AND 31.0 Mev. K. Miyake, K. F. Kinsey, and D. E. Knapp (Univ. of Rochester, N. Y.). Phys. Rev., 126: 2188-96(June 15, 1962). (NYO-9545)

Differential and total cross sections at 31.0 Mev and total cross sections at 20.7 Mev were measured for the reaction $\pi^- + p \rightarrow \pi^0 + n$. A thin-walled liquid hydrogen target was used. The gamma telescopes used a Čerenkov counter to identify the conversion electrons and a thin-lead converter to avoid complications from cascade processes. The angular distribution in mb/sr at 31.0 Mev is: $d\sigma/d\Omega = (1.00 \pm 0.02)[(0.51 \pm 0.04) - (0.61 \pm 0.11)P_1(\cos\theta) + (0.12 \pm 0.36)P(\cos\theta)]$. The total cross sections at 31.0 and 20.7 Mev are 6.5 ± 0.5 and 5.4 ± 0.4 mb, respectively. The

data are analyzed in terms of the phase shifts α_{ij}. Assuming that the S-wave phase shifts extrapolate to zero pion energy as $\alpha_i = a_i\eta$, where η is the pion momentum in the c.m. system in units of $m_\pi c$, the quantity $(a_1 - a_3) = 0.27 \pm 0.02$. This agrees with Hamilton and Woolcock's prediction from photoproduction and the Panofsky ratio $(a_1 - a_3) = 0.245 \pm 0.01$. There are theoretical and experimental grounds for a nonlinear behavior of α_3 and α_1, which should improve the agreement. (auth)

26128 EXPERIMENTAL CONSEQUENCES OF THE HYPOTHESIS OF REGGE POLES. S. C. Frautschi (Cornell Univ., Ithaca, N. Y.), M. Gell-Mann, and F. Zachariasen. Phys. Rev., 126: 2204-18(June 15, 1962).

In the nonrelativistic case of the Schrödinger equation, composite particles correspond to Regge poles in scattering amplitudes (poles in the complex plane of angular momentum). It was suggested that the same may be true in relativistic theory. In that case, the scattering amplitude in which such a particle is exchanged behaves at high energies like $s^{\alpha(t)}\,[\sin\pi\alpha(t)]^{-1}$, where s is the energy variable and t the momentum transfer variable. When $t = t_R$, the mass squared of the particle, then α equals an integer n related to the spin of the particle. In contrast, the case of a field theory in which the exchanged particle is treated as elementary may be considered and each order of perturbation theory may be examined. When $n > 1$, renormalization is usually impossible; when $n \leq 1$ and the theory is renormalizable, the high-energy behavior is typically $s^n(t-t_R)^{-1}\,\phi(t)$. Thus an experimental distinction is possible between the two situations. A set of rules for finding the high-energy behavior of scattering cross sections according to the Regge pole hypothesis is suggested and they may be applied to π-π, π-N, and N-N scattering. These cross sections differ from those expected when there are "elementary" nucleons and mesons treated in renormalized perturbation theory. For the case of N-N scattering, preliminary experimental data are analyzed, and there are indications that an "elementary" neutral vector meson is probably not present. Reactions are proposed to test the "elementary" or "composite" nature of other baryons and mesons. Higher energies may be needed. (auth)

26129 PERTURBATION THEORY OF PION-PION INTERACTION. II. TWO-PION APPROXIMATION. Tai-tsun Wu (Harvard Univ., Cambridge, Mass.). Phys. Rev., 126: 2219-26(June 15, 1962).

Using the model of a four-particle direct interaction without derivative coupling, relations are obtained between the renormalized quantities related to pion-pion interactions. Considering only the two-pion intermediate states but preserving crossing symmetry and unitarity up to the production threshold, closed systems of nonlinear integral equations are obtained approximately describing the low-energy pion-pion scattering. (auth)

26130 HIGH-ENERGY NEUTRINO REACTIONS WITHOUT PRODUCTION OF INTERMEDIATE BOSONS. T. D. Lee and C. N. Yang (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 126: 2239-48(June 15, 1962).

General forms of cross sections for neutrino and antineutrino reactions at high energies are discussed. Consequences of the point structure of lepton currents are investigated. Efforts are made to separate out the results implied by different assumptions concerning weak interactions such a time-reversal invariance, conserved vector-current hypothesis, and $|\Delta I| = 1$ rule. (auth)

26131 SELF-CONSISTENT MODEL FOR NONLEPTONIC DECAYS OF Σ AND Λ HYPERONS. Virendra Singh and Bhalchandra M. Udgaonkar (Univ. of California, Berkeley). Phys. Rev., 126: 2248-51(June 15, 1962). (UCRL-9863)

A self-consistent calculation of pionic Σ and Λ decays was carried out in the pole approximation of an S matrix approach to study the angular momentum in which the decay $\Sigma^+ \rightarrow n\pi^+$ takes place, the relative (ΣΛ) parity, and the possible existence of other than global symmetric solutions. The model predicts that $\Sigma^+ \rightarrow n\pi^+$ decay must occur in the s wave and that (ΣΛ) parity is even. (auth)

26132 N/D METHOD. M. Sugawara and A. Kanazawa (Purdue Univ., Lafayette, Ind.). Phys. Rev., 126: 2251-5 (June 15, 1962).

A rigorous mathematical discussion of the N/D method is presented. The N/D solution is the correct one in the sense that the D function has no redundant zeros; the high-energy behavior of the phase shift in the solution obtained is examined. The N/D method exhausts all the possible solutions of the original equation systematically, according to the high-energy behavior of the phase shift. Virtually the same arguments are applicable to the inverse method. The N/D method is preferable to the inverse method for both technical and physical reasons. (auth)

26133 HIGH-ENERGY BEHAVIOR OF NUCLEON ELECTROMAGNETIC FORM FACTORS. R. G. Sachs (Univ. of Wisconsin, Madison). Phys. Rev., 126: 2256-60 (June 15, 1962).

Theoretical implications of the suggestion that the observed nucleon electromagnetic form factors indicate the existence of a nucleon "core" are discussed. On the basis of physical arguments concerning the nature of such a core, it is shown that, for the neutron, the charge form factor, $F^n_{ch}(q^2)$ and the magnetic form factor, $F^n_{mag}(q^2)$ vanish as q^2, the invariant momentum transfer, increases without limit. For the proton, $F^p_{ch}(q^2) \rightarrow Z_1^{(s)}$ and $F^p_{mag}(q^2) \rightarrow Z_1^{(s)}/2M$, where $Z_1^{(s)}$ is the wave function renormalization constant for strong interactions, which is a measure of the probability of the "core state." In terms of the Dirac form factor, $F_1(q^2)$, and the Pauli form factor, $F_2(q^2)$, these results read $F_1^p(q^2) \rightarrow 0$, $F_1^n(q^2) \rightarrow Z_1^{(s)}$, and $q^2F_2(q^2) \rightarrow 0$ for both neutron and proton. The results for $F_1(q^2)$ are the same as those obtained by I. K. Hiida, et al. (Prog. Theoret. Phys. (Kyoto) 22: 247(1959)). The other result implies the existence of a relationship that may be used to eliminate one parameter in the analysis of F_2. The generality of the interpretation of F_{ch} and F_{mag} as Fourier transforms of distributions of charge and magnetization, respectively, is demonstrated. (auth)

26134 PRODUCTION OF STRANGE-PARTICLE RESONANT STATES BY 2.1-Bev/c π^- MESONS. Gideon Alexander, George R. Kalbfleisch, Donald H. Miller, and Gerald A. Smith (Univ. of California, Berkeley). Phys. Rev. Letters, 3: 447-50(June 1, 1962).

Interactions of mesons (π^-) on protons at about 2.1 Bev/c resulting in the production of a visible hyperon are measured and fitted kinematically. The distributions of the interactions resulting in $\Lambda\pi K$ and $\Sigma\pi K$ final states are shown. An $I = 0$ $\Sigma\pi$ resonance is observed at a mass (M_{Σ^*}) of 1405 Mev, and it is suggested that this resonance be identified with a bound S^0 state of the KN system. A second $\Sigma\pi$ resonance at $M_{\Sigma^*} = 1510$ to 1560 Mev, $K\pi$ resonances at $M_{K^*} = 730$ and 885 Mev, and a $\Lambda\pi$ resonance at $M_{\Lambda^*} = 1385$ Mev, are also studied. The widths, strengths, and masses of these resonances are discussed. (T.F.H.)

26135 EXPERIMENTAL STUDIES OF THE FORM FACTORS IN $K_{\mu 3}^+$ AND K_{e3}^+ DECAY. John L. Brown (Univ. of California, Berkeley), John A. Kadyk, George H. Trilling, Remy T. Van de Walle, Byron P. Roe, and Daniel Sinclair. Phys. Rev. Letters, 8: 450-3(June 1, 1962).

The form factors for $K_{\mu 3}^{+}$ decay are calculated from an analysis of 76 observed events. The factors obtained are compared with known values for K_{e3}^{+}, and it is found that within the framework of the Fermi V—A interaction the muon and electron are coupled identically in $K_{\mu 3}^{+}$ and K_{e3}^{+} decays respectively. (T.F.H.)

26136 EXPERIMENTAL EVIDENCE FOR A QUASI-MONOCHROMATIC BREMSSTRAHLUNG INTENSITY FROM THE FRASCATI 1-Gev ELECTRONSYNCHROTRON. G. Barbiellini, G. Bologna, G. Diambrini, and G. P. Murtas (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Phys. Rev. Letters, 8: 454-7(June 1, 1962).

The bremsstrahlung produced by bombarding a diamond single crystal with 1-Bev electrons has a line structure. The crystal is originally oriented with its (110) axis perpendicular to the incident electron beam. In order to obtain the desired structure, the crystal is rotated through a slight angle (less than 23 mradian) toward the $(1\bar{1}0)$ axis. The 150, 300, and 465 Mev "lines" produced by this method are shown. All the lines have a low-intensity continuum up to 1 Bev. (T.F.H.)

26137 S-WAVE $\bar{K}$-N SCATTERING AMPLITUDES. T. Akiba and R. H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev. Letters, 8: 457-9(June 1, 1962).

The relative phase of the S-wave isotopic spin 0 and 1 $K+N \rightarrow \Sigma + \pi$ amplitudes is denoted by $\phi_\gamma = \phi_0 - \phi_1$. The experimental data strongly suggest that $\phi_\gamma = -110°$ at 400 Mev/c, and since no violent fluctuations occur in the Σ^-/Σ^+ ratio between 400 and 175 Mev/c, it is concluded that ϕ_γ is negative below 175 Mev/c. It is shown that this result suggests that the real part of the isotopic-spin 0 scattering amplitude is appreciably negative at the $\bar{K}$-N threshold, and that the $\Sigma\pi$ resonance at a mass of 1405 Mev is an S-wave resonance of the Dalitz-Tuan type. (T.F.H.)

26138 DECAY MODES OF THE η MESON. Laurie M. Brown and Paul Singer (Northwestern Univ., Evanston, Ill.). Phys. Rev. Letters, 8: 460-1(June 1, 1962).

Assuming the 550-Mev, T = 0, 3π resonance (η meson) is a pseudoscalar particle of positive G parity, the partial rates of the electromagnetically permitted decay final states are investigated. The rate for the $\pi^+\pi^-\gamma$ final state is proportional to α ($\alpha = 1/137$), that for 3π and 2γ is proportional to α^2, and that for $\pi^0 e^+ e^-$ and $\pi^0\mu^+\mu^-$ is proportional to α^4, on the basis of the electromagnetic-interaction theory alone. It is shown that if the decay to the 3π final state is enhanced by the existence of a strong final-state 2π interaction, calculated partial rates are obtained that are consistent with the experimental values. The calculations also yield that the total width of the η meson is about 250 ev, with a corresponding lifetime of about 3×10^{-18} sec. (T.F.H.)

26139 IS THE PHOTON AN ELEMENTARY PARTICLE? R. Blankenbecler, L. F. Cook, and M. L. Goldberger (Princeton Univ., N. J.). Phys. Rev. Letters, 8: 463-5 (June 1, 1962).

An argument is given on the basis of S-matrix theory, as follows: photons interact with all charged particles, including strongly interacting ones; hence, if the strongly interacting particles are nonelementary, then the photon must also be nonelementary. The consequences of the hypothesis of photon nonelementarity, and means for testing its validity by studies at high energies, are discussed. Assuming that the photon is nonelementary, it is hypothesized that it is associated with a Regge trajectory with odd signature having the property that $\alpha_1(0) = 1$. (T.F.H.)

26140 MEASUREMENT OF THE TRIPLE SCATTERING PARAMETER D_t IN THE FREE n–p SYSTEM. P. M. Patel, A. Carroll, N. Strax, and D. Miller (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 8: 491-2(June 15, 1962).

A 128-Mev neutron beam having a polarization of 42% impinges on a liquid H_2 target, and the asymmetry of the recoil protons is determined using a second scattering by C analyzers. The neutron beam can be processed through 180° by means of a precession magnet, thus allowing a wide range of asymmetry data to be accumulated. The triple scattering parameter D_t is found as a function of the barycentric scattering angle from 120 to 160°, and is compared with the predictions of several sets of semiphenomenological phase shift solutions. The experimental results discriminate sharply against all solutions except the so-called "YLAN3M" set; this set approximates the form of the experimental data. (T.F.H.)

26141 DECAY OF A NEGATIVE HYPERON INTO $\Lambda^0 + e^- + \bar{\nu}$. L. Bertanza (Brookhaven National Lab., Upton, N. Y.), V. Brisson, P. L. Connolly, E. L. Hart, I. S. Mittra, G. C. Moneti, R. R. Rau, N. P. Samios, I. O. Skillicorn, S. S. Yamamoto, J. Leitner, and J. Westgard. Phys. Rev. Letters, 9: 19-21(July 1, 1962).

Hyperon decay $Y^- \rightarrow \Lambda^0 + e^- + \bar{\nu}$ in which the hyperon can be either a Ξ^- or a Σ^- was detected in a 20-in. hydrogen bubble chamber, using a 2.24-Bev/c K^- beam. Kinematic variables and ionization densities of each track were measured. Data are presented in graphical and tabular forms. (L.N.N.)

26142 OBSERVATION OF RADIATIVE CAPTURE OF NEGATIVE MUONS IN IRON. G. Conforto, M. Conversi, and L. di Lella (CERN, Geneva). Phys. Rev. Letters, 9: 22(July 1, 1962).

The reaction $\mu^- + N \rightarrow N^1 + \nu + \gamma$ was detected; rates of occurrence under given conditions were measured. Feasibility of experiments on the coupling constants, the circular polarization, and the γ asymmetry of gamma emission from radiative capture of polarized muons by spinless nuclei was estimated. Evidence for occurrence of the process in Fe with a branching ratio of about 10^{-4} was found. (L.N.N.)

26143 APPARENT VIOLATION OF THE $\Delta S = \Delta Q$ RULE BY LEPTONIC Σ^+ DECAY. Angela Barbaro-Galtieri, Walter H. Barkas, Harry H. Heckman, Jack W. Patrick, and Frances M. Smith (Univ. of California, Berkeley). Phys. Rev. Letters, 9: 26-9(July 1, 1962).

The decay $\Sigma^+ \rightarrow n + \mu^+ + \nu$ was detected in an emulsion stack exposed to K^- mesons. The Σ^+ was formed in a proton interaction with a K^- meson. Data are presented in graphical and tabular forms. (L.N.N.)

26144 HEAVY PIONS AND THE π-N VERTEX FUNCTION. Mirza A. Baqi Bég and Paul C. DeCelles (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 30-1(July 1, 1962).

A final $3\text{-}\pi$ state having an I = 1 assignment indicates a resonant O^- state having a neutral member that is even under charge conjugation. Spin-parity-charge conjugation properties are suggested; the decay preserves isotopic spin. The particle has the same quantum numbers as the π except for its larger mass. (L.N.N.)

26145 HIGH-ENERGY NUCLEON-NUCLEON TOTAL CROSS SECTIONS. A. N. Diddens, E. Lillethun, G. Manning, A. E. Taylor, T. G. Walker, and A. M. Wetherell (CERN, Geneva). Phys. Rev. Letters, 9: 32-4(July 1, 1962).

Transmission measurements of (p-d)−(p-p) and p-p total cross sections, including diffraction scattering, at 3.3 to 7.8 Bev/c, were performed. The (p-d)−(p-p) cross section was constant. (L.N.N.)

26146 EXPERIMENTAL CROSS SECTION FOR $\pi\pi \rightarrow K\bar{K}$. A. R. Erwin, G. A. Hoyer, R. H. March, W. D. Walker, and T. P. Wangler (Univ. of Wisconsin, Madison and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 34-6(July 1, 1962).

Rough values were determined for isospin dependence and cross sections for the reactions $\pi^- + p \rightarrow K^0 + \bar{K}^0 + n$, $\pi^- + p \rightarrow K^- + K^0 + p$, and $\pi^- + p \rightarrow K^+ + K^- + n$ at 1.89 and 2.10 Bev/c in the Adair 14-in. hydrogen bubble chamber. Kaons produced in pairs tend to peak forward in the center-of-mass system, indicating that a peripheral interaction may be involved. Angular distributions were measured, and high-impact-parameter interactions are indicated. (L.N.N.)

26147 OBSERVATION OF HIGH-ENERGY NEUTRINO REACTIONS AND THE EXISTENCE OF TWO KINDS OF NEUTRINOS. G. Danby, J-M Gaillard, K. Goulianos, L. M. Lederman, N. Mistry, M. Schwartz, and J. Steinberger (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 36-44(July 1, 1962).

From the reaction $\pi^s \rightarrow \mu^s + (\nu/\nu^-)$, it is demonstrated that the neutrinos produce μ mesons but not electrons and are likely to be different from the neutrinos involved in beta decay. Approximate cross sections are determined. (L.N.N.)

26148 ELECTROMAGNETIC EFFECTS ON DECAYS OF G EIGENSTATES. G. Feinberg (Columbia Univ., New York) and A. Pais. Phys. Rev. Letters, 9: 45-6(July 1, 1962).

Theorems on the effects of electromagnetic deviations from charge independence on boson decay are presented. The theorems are valid when electromagnetism is treated to the lowest nonvanishing order. (L.N.N.)

26149 MEASUREMENT OF THE Σ^- ASYMMETRY PARAMETER. Robert D. Tripp, Mason B. Watson, and Massimiliano Ferro-Luzzi (Univ. of California, Berkeley). Phys. Rev. Letters, 9: 66-7(July 15, 1962). (UCRL-10238)

Asymmetry parameters α in Σ^s decay are determined from decay asymmetries. Measurements of α for $\Sigma_+^+ \rightarrow n\pi^+$ (called α_+) and $\Sigma_0^+ \rightarrow p\pi^0$ (called α_0) agree with previous values. The α_- for $\Sigma_-^- \rightarrow n\pi^-$ resisted measurement via the decay asymmetry, due to uncertainty in Σ^- polarization. Using a previous method (R. D. Tripp et al., Phys. Rev. Letters, 8: 175(1962)), the helicity α_- was determined at -0.16 ± 0.21. (L.N.N.)

26150 CORRESPONDENCE BETWEEN τ AND η DECAYS. Mirza A. Baqi Beg (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 9: 67-9(July 15, 1962).

If τ' decay is adequately described by the π pole term, the π^0 spectrum in $\eta \rightarrow \pi^+\pi^-\pi^0$ is identical with the π^+ spectrum in τ^{+1} decay. This similarity of Dalitz plots, which agrees with data, is a general consequence of the quantum numbers attributed (0^{-+}, T = 0) to the η. This result cannot be used as a test of these specific decay models, but may be used as a check on quantum-number assignments. (L.N.N.)

26151 EXPERIMENTAL TESTS OF THE $\Delta I = \frac{1}{2}$ RULE, AND THE $\Delta S = +\Delta Q$ RULE IN THREE-BODY DECAYS OF NEUTRAL K MESONS. Gideon Alexander, Silverio P. Almeida, and Frank S. Crawford, Jr. (Univ. of California, Berkeley). Phys. Rev. Letters, 9: 69-74 (July 15, 1962).

Results of an experiment using the 3-body decays of K^s were used to test rules suggested for strange-particle decay. These rules are: $\Delta I = \frac{1}{2}$(NL), for nonleptonic (NL) decays; $\Delta I = \frac{1}{2}$(L) for strangeness-changing leptonic (L) decays; and $\Delta S = +\Delta Q$, correlating the changes in strangeness (S) and charge of the strongly interacting particles in S-changing L decay. Data are incompatible with these rules. (L.N.N.)

26152 ONE-PION-EXCHANGE MODEL AND EVIDENCE THAT THE SPIN OF THE ζ IS EVEN. Allen E. Everett (Tufts Univ., Medford, Mass.). Phys. Rev. Letters, 9: 74-6(July 15, 1962).

In the reaction $\pi^s + p \rightarrow \pi^s + \pi^0 + p$ below 1 Bev, there is a peak in the 2-π mass spectrum near $E_\zeta = 575$ Mev; this peak is ζ. It is shown that data strongly indicate that the isotopic spin is even. If the spin were odd, the particle could be coupled by strong interactions to a 2-π, T = 1 state. (L.N.N.)

26153 π-N SCATTERING LENGTH AND SINGULARITIES IN THE COMPLEX J PLANE. Keiji Igi (Univ. of California, Berkeley). Phys. Rev. Letters, 9: 76-9 (July 15, 1962).

A sum rule enabling experimental investigation as to whether there are Regge poles only or whether there exist cuts in the complex angular momentum plane is proposed. (L.N.N.)

26154 REGGE POLES AND DIFFRACTION SCATTERING. P. T. Matthews (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 80: 1-12 (July 1, 1962).

A review lecture is presented on the possible application of Regge poles to the analysis of high-energy elementary particle diffraction scattering. (auth)

26155 ELEMENTARY PARTICLE RESONANCES. Abdus Salam (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 80: 13-27(July 1, 1962).

The theoretical interpretation of elementary particle resonances is reviewed. The generalization of isotopic spin to invariance under the group U_3 is discussed, and a number of predictions of the Sakata model and 'eightfold way' are illustrated. Various dynamical models of the resonances are described and some suggestions made about the implications of the mass splitting within particle multiplets. (auth)

26156 UNITARY SYMMETRY. P. T. Matthews and Abdus Salam (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 80: 28-38(July 1, 1962).

The notion of unitary symmetry is expressed in terms of more familiar concepts. The physical restrictions imposed by U_3 invariance are expressed in terms of isotopic spin and generalized charge symmetry operations. The simple multiplets are developed. As examples, meson−Sakaton scattering is expressed in terms of three invariant amplitudes, and relations are found for the decay of a Sakaton-antiSakaton pair into two bosons. (auth)

26157 ON DECAY PROBABILITIES OF ρ, ω AND K* PARTICLES. C. H. Chan (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 80: 39-45 (July 1, 1962).

Tables are presented for various spin and parity assignments. (auth)

26158 EXPERIMENTAL DATA ON NEW RESONANCES. G. R. Lynch (Univ. of California, Berkeley). Proc. Phys. Soc. (London), 80: 46-62(July 1, 1962). (UCRL-10167)

The experimental evidence for elementary particle resonances, other than the pion–nucleon resonances, is presented. The properties of the four pion–hyperon resonances, as well as those of the K^*, ρ, ω, and η mesons, are discussed. Emphasis is placed on the experimental determination of the spin, parity, and G parity of the ω and η particles. (auth)

26159 HIGH ENERGY PERIPHERAL AND DIFFRACTION SCATTERING. A. M. Wethedrell (CERN, Geneva). Proc. Phys. Soc. (London), 80: 63-77(July 1, 1962).

A review is given of high-energy proton–proton and pion–proton elastic scattering and inelastic scattering with small inelasticity. (auth)

26160 THE SAKATA MODEL AND THE K_{l3} + DECAYS. Osamu Hara and Hisao Takebe (Univ. of Minnesota, Minneapolis). Progr. Theoret. Phys. (Kyoto), 27: 444-8(Mar. 1962). (In English)

The energy spectra of charged leptons from K^+_{l3} and the branching ratio between $K^+_{\mu 3}$ and K^+_{e3} are explained using the Sakata model. (auth)

26161 PION-HYPERON RESONANCE. Yoshio Matsuzaki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 27: 461-73(Mar. 1962). (In English)

A dispersion theoretical technique (G. Feldman, et al., Nuovo cimento 16: 549(1960)) is used to derive static equations for pion-hyperon scattering. The general treatment for the system with three channels, i.e. the π-Λ, π-Σ, and $\overline{K}$-N channels, is presented. The resonance energy, the half width, and the branching ratio of the Y_1^* decay are calculated. Although there are ambiguities due to the cutoff energy and the relative magnitudes of coupling constants, including the $\overline{K}$-N channel changes the conclusions obtained assuming no $\overline{K}$-N channel. Assuming the parities of strange particles as $P_{KYN} = -1$ and $P_{\Sigma\Lambda} = +1$ there can, in principle, be a resonance state for any of the I = 0, 1, and 2 states. For example, even if the global symmetry ($f_{N^2} = f_{\Lambda^2} = f_{\Sigma^2}$) is assumed, there is a Y_1^* resonance with $J = \frac{1}{2}$ and I = 1, as a result of including the $\overline{K}$-N channel. (auth)

26162 COLLECTIVE DESCRIPTION OF A SYSTEM OF INTERACTING BOSE PARTICLES. [PART] I. Sigenobu Sunakawa, Yoshimatsu Yoko-o and Hiroshi Nakatani (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 589-99(Mar. 1962). (In English)

The collective description of the one-dimensional interacting Bose system is studied. The exact canonical conjugate of the density operator is given explicitly. The Hamiltonian of the system is expressed in terms of the exact collective variables. (auth)

26163 COLLECTIVE DESCRIPTION OF A SYSTEM OF INTERACTING BOSE PARTICLES. [PART] II. Sigenobu Sunakawa, Hiroshi Nakatani, and Yoshimatsu Yoko-o (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 600-7(Mar. 1962). (In English)

The collective behavior of the three-dimensional Bose system is investigated. The momentum density operator is modified: the modified momentum density operator is equivalent to the velocity operator of the quantum hydrodynamics. The Hamiltonian is described in terms of collective variables for irrotational motion. Results are compared with other theories. (auth)

26164 HEAVY MESONS AND ANOMALOUS MAGNETIC MOMENTS OF NUCLEONS. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 27: 610-11(Mar. 1962). (In English)

The anomalous magnetic moments of nucleons are obtained; effects of ω, ρ, and η mesons are considered, assuming the η is also a vector meson. Vector-type interactions are adopted as the interaction Hamiltonians in the vector meson-nucleon systems. Results show that $\Delta\mu_P \simeq 1.66$ and $\Delta\mu_N = -1.66$; calculations agree fairly well with data. (L.N.N.)

26165 NOTE ON RESONANT STATES IN THREE-PION SYSTEM. Shigeo Minami (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 27: 612-14(Mar. 1962). (In English)

The reaction $\pi^+ + d \rightarrow p + p + X^0$ is examined to study phenomena related to the real and the virtual X^0, where X^0 represents the η or the ω meson. The Λ-N force due to exchange of one heavy meson is discussed. (L.N.N.)

26166 NON-STATIC EFFECTS IN OPEP: PS(PV) CASE. Philip Connors and Peter Signell (Pennsylvania State Univ., University Park). Progr. Theoret. Phys. (Kyoto), 27: 614-15(Mar. 1962). (In English)

Applying a numerical method (P. Connors and P. Signell, Prog. Theoret. Phys. 26: 757(1961)), complete one-pion exchange potential (OPEP) shifts were computed for pseudovector coupling and compared with the static and the complete OPEP phases. Results are presented in tabular form. (L.N.N.)

26167 ON THE β-DECAY OF Λ AND Σ^- HYPERONS. Kimio Fujimura, Tsuneyuki Kotani, and Tetsuya Saito (Tokyo Metropolitan Univ.). Progr. Theoret. Phys. (Kyoto), 27: 616-18(Mar. 1962). (In English)

Data on transition probabilities of β-decay modes of hyperons were about 0.1 as large as calculated values. Theoretical-value corrections are determined by considering baryon structures. (L.N.N.)

26168 QUANTUM STATISTICAL MECHANICS OF A MANY-BODY SYSTEM WITH SQUARE-WELL INTERACTION. R. K. Pathria and M. P. Kawatra (Univ. of Delhi). Progr. Theoret. Phys. (Kyoto), 27: 638-52(Apr. 1962). (In English)

Following the binary collision approach to the many-body problem in quantum statistical mechanics, as developed by Lee and Yang, the equation of state to the order α^2/λ^2 is derived for a system of particles interacting through a square-well potential and obeying Bose-Einstein or Fermi-Dirac statistics. λ is the mean thermal wavelength of the particles, and α represents the range of the two-body interaction. Expressions are obtained for the 2nd and the 3rd virial coefficients of the system and for its thermodynamical properties such as energy, specific heat, and entropy, at finite but low temperatures. (auth)

26169 PION-NUCLEON SCATTERING AND PION-PION INTERACTION. Atsushi Takahashi (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 27: 665-81(Apr. 1962). (In English)

Applying the Cini-Fubini approximation to the Mandelstam representation for π-N scattering amplitudes, effects of the π-π interaction to be added to the dispersion relation given by Chew, Goldberger, Low, and Nambu are considered explicitly. Constant parameters are introduced through a subtraction. In the dispersion relations thus obtained, the integral over the branch cut extending $4\mu^2$ to ∞ is calculated by a method similar to that of W. R. Frazer and J. R. Fulco (Phys. Rev., 117: 1603,1609(1960)), but using one more subtraction to avoid the divergence regarding the left-hand cut. Comparing dispersion relations with data on π-N scattering, properties of I = 0 (S-wave) π-π interactions are investigated. The interaction is attractive, and the magnitude of scattering length is 0.05 ~ 0.2 μ^{-1}. This is still one order smaller as compared with

recent data. The necessity of another parameter is discussed. (auth)

26170 A SEMI-PHENOMENOLOGICAL APPROACH TO MULTIPLE MESON PRODUCTION. Kazuaki Daiyasu (Osaka Univ.), Keizo Kobayakawa, Nobuo Yajima, and Hiroyuki Yokomi. Progr. Theoret. Phys. (Kyoto), 27: 732-46(Apr. 1962). (In English)

A theoretical approach to the fire ball model in multiple meson production is made. Assuming that two fire balls are produced in a peripheral nucleon-nucleon collision and that the fire balls can be regarded as unstable spinless bosons, field-theoretically calculated quantities concerning their production process, such as angular and energy distributions and transverse momentum of the fire ball and inelasticity, were calculated. Niu's relation is checked. The calculations are carried out for the cases in which the boson interacts with the nucleon or the pion. Results are not inconsistent with the general features of the data. (auth)

26171 INTERACTION BETWEEN ALPHA PARTICLES. Ichirō Shimodaya, Ryōzō Tamagaki, and Hajime Tanaka (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 27: 793-810(Apr. 1962). (In English)

Effective α-α potential is investigated from the standpoint of the cluster model using reliable properties of the pion-theoretical nucleon-nucleon potentials. The main features of α-α potential (outside attraction, inside repulsion, and angular momentum dependence) demanded from the analyses of low energy α-α scattering phenomena can be qualitatively reproduced. In constructing the α-α potential, the importance of the Pauli principle, which damps the relative wave function of two α-particles at small α-α distances, should be emphasized. Its connection with nucleon-nucleon potentials is discussed. (auth)

26172 A NEW APPROACH TO GREEN'S FUNCTION OF A PARTICLE IN ONE DIMENSION. Hirotsuga Matsuda (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 811-36 (Apr. 1962). (In English)

The Schrödinger equation of a particle moving in one dimension in a given static potential is solved. The density matrix corresponds to a Laplace transform of Green's function and satisfies a diffusion-type equation which may be regarded as representing a certain limit of a discrete Markoffian random walk process. The space occupied by the system is divided into nonoverlapping regions; in each, the Schrödinger equation can be solved. A path concept is introduced to synthesize the solutions for the regions and formulate the one-particle Green's function. The energy bands of a one-dimensional infinite system are discussed. The condition for the existence of the impurity band is derived, which qualitatively supports Anderson's theory on the absence of diffusion in certain random lattices. (auth)

26173 COLLECTIVE VARIABLES AND THEIR CANONICAL CONJUGATE MOMENTA IN MANY-BODY PROBLEM. Kunio Yamamoto (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 838-40(Apr. 1962). (In English)

Assuming the canonical formalism is useful in describing collective motion, the physical meanings of the method for finding the canonical conjugate momenta of the collective variables described by S. Sunakawa et al., (Progr. Theoret. Phys., 27: 589,600(1962)) and of the method for judging the completeness of the collective variables of the system are described. (L.N.N.)

26174 PION PRODUCTION IN PION-NUCLEON SCATTERING AND PION-PION INTERACTION. Miwae Yamazaki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 27: 843-5(Apr. 1962). (In English)

The reaction $\pi + N \rightarrow 2\pi + N$ is discussed. The production process is assumed to take place mainly via π-π interactions, which are studied using an extrapolation formula (G. F. Chew and F. E. Low, Phys. Rev., 113: 1640 (1959)). A program giving a consistent explanation to the process at 0.3 to 1.5 Bev is presented. (L.N.N.)

26175 ω-N INTERACTION AND $p + \bar{p} \rightarrow \omega + \omega$ REACTION. Shigeo Minami, Yoneji Miyamoto, and Naohiko Masuda (Osaka City Univ.). Progr. Theoret. Phys. (Kyoto), 27: 846-7(Apr. 1962). (In English)

The reaction $p + \bar{p} \rightarrow 2\omega$ is studied to estimate the coupling-constant value in the ω-N system. Angular distributions and the excitation function of the reaction are examined. (L.N.N.)

26176 THE INTERACTION OF BODIES RADIATING GRAVITATIONAL WAVES. K. P. Stanyukovich. Vestnik Moskov. Univ., Ser. III, No. 1, 78-90(Jan.-Feb. 1962). (In Russian)

The mechanism of gravitation wave emission by nucleons was studied postulating that their energy is carried away as wave particles (gravitation quanta). The process is described by means of relativistic hydrodynamics. The results are numerically identical to results obtained in the theory of quadrupole gravitational wave emission in the general theory of relativity. (tr-auth)

26177 ON THE QUESTION OF POLARIZABLE PROPERTIES OF ELECTRONS OF μ^x MESON DISINTEGRATION. B. K. Kerimov, Yu. A. Popov, Yu. M. Loskutkov, and L. P. Galkina. Vestnik Moskov. Univ., Ser. III, No. 2, 29-35(Mar.-Apr. 1962). (In Russian)

Probabilities of longitudinally polarized μ^x decay at rest were calculated considering the longitudinal and transverse electron polarization for two variations of Hamiltonian (Y,A) interactions. The non-polarized decay electrons are clearly observed, and events where Lee–Yang and Feynman–Gell-Mann variations are not equivalent entities are found. (tr-auth)

26178 ESTIMATE OF THE DEPOLARIZATION OF TRANSVERSELY POLARIZED ELECTRONS EMITTED FROM THIN SOURCES. Bernard Blake and Bernhard Muehlschlegel (Univ. of Illinois, Urbana). Z. Physik, 167: 584-7(1962). (In English)

The depolarization of transversely polarized electrons in radioactive sources was estimated under simplifying assumptions. It was shown that the contribution of multiple scattering is almost negligible, whereas single scattering leads to a relative depolarization which, at given compositions and dimensions of the source, can have the order of magnitude of 10%. (tr-auth)

26179 ON ELASTIC HIGH ENERGY PROTON-PROTON SCATTERING. E. N. Tsyganov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1456-60(June 1962). (In Russian)

Elastic p-p scattering at 5.2 Bev is studied using photographic emulsions. The differential cross section at 1.8 to 10.5° in the center-of-mass system is obtained. The energy dependence of the p-p interaction radius at 2 to 9 Bev is considered in the quasi-classical approximation. The mean square radius increases from 0.69 ± 0.02 f at 2.24 Bev to 1.20 ± 0.05 f at 8.5 Bev. (auth)

26180 ELASTIC SCATTERING OF 7.2 Bev π^--MESONS ON PROTONS. M. S. Ainutdinov, S. M. Zombkovskii, S. Ya. Nikitin, and Ya. M. Selektor (Inst. of Theoretical and Ex-

perimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1495-8(June 1962). (In Russian)

The differential cross section for π^--p scattering at 4 to 13.3° (in the center-of-mass systems). The results obtained can be satisfactorily described by the optical model of the proton. (auth)

26181 EXCLUSION OF DIVERGENCES FROM THE SCATTERING MATRIX. D. A. Slavnov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 1543-53(June 1962). (In Russian)

A method for constructing the scattering matrix is proposed, which does not involve divergences. The absence of diverging expressions at all stages of the calculations is attained by employing a special representation for chronological contraction in the form of a limit (in the generalized sense of the word) of some functions. If certain conditions are imposed on the parameters on which these functions depend, all elements of the S-matrix are finite and identical with the regularized matrix elements constructed by the perturbation theory procedure. Unlike ordinary regularization, no compensating infinite quantities are introduced. (auth)

26182 LIMITS FOR THE POSSIBLE MAGNETIC MOMENT OF THE K^0-MESON. E. O. Okonov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1554-7(June 1962). (In Russian)

From data obtained using the synchrophasotron the upper limit of a possible magnetic moment of the K^0 meson is estimated at $\mu \leq 0.04\ \mu_0$, where $\mu_0 = he/M_K$. The values $\mu \geq 20\ \mu_0$ lead to a much larger productions cross section for $K(\bar{K}^0)$ as compared with the cross section for K^+ production. (auth)

26183 EFFECT OF THE GRADIENT OF A STRONG ELECTROMAGNETIC RAY ON ELECTRONS AND ATOMS. G. A. Askaryan (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 1567-70(June 1962). (In Russian)

The transverse inhomogeneity of a strong electromagnetic ray can exert a strong effect on electrons and atoms of a medium. If the wave frequency exceeds the proper frequency of the electron; oscillations (in a plasma or in atoms), the electrons or atoms will be forced out of the ray field. At sub-resonance frequencies, the particles will be pulled in, the force being especially large at resonance. A rarefication or compression may occur in the ray or in the focus of the radiation; the pressure gradient near the hole connecting the evacuated vessel with the atmosphere may be maintained, and a channel conducting charged particles may be created in the medium. A strong thermal, ionizing, and separating effect of the ray on the medium can be used for setting up wave guide conditions of propagation and for eliminating divergency of the ray (self-focusing). Hollow rays may ensure directed flow and ejection of the plasma along the ray axis for plasma transport and creation of plasma current conductors. The possibilities of acceleration and heating of plasma electrons by a modulated ray are indicated. (auth)

26184 ON EXPERIMENTAL INVESTIGATION OF THE STRUCTURE OF A VECTOR CURRENT IN WEAK INTERACTIONS. Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1608-10(June 1962). (In Russian)

It is shown that some of the hypotheses regarding the structure of a vector current in weak interactions can be verified by investigating processes of the type: neutrino + baryon → charged lepton + baryon + meson. (auth)

26185 ANGULAR DISTRIBUTIONS OF THE DECAY PRODUCTS OF INTERMEDIATE VECTOR MESONS IN THE $e^+ + e^- \rightarrow B^+ + B^-$ PROCESS. Nguyen Van Hieu (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1611-13(June 1962). (In Russian)

Probabilities of decay channels of intermediate vector mesons are estimated. The angular distribution of products of lepton decay of intermediate vector mesons produced in the $e^+ + e^- \rightarrow B^+ + B^-$ process depends on the anomalous magnetic moment of the mesons. (auth)

26186 ANALYTIC PROPERTIES OF NONRELATIVISTIC DIAGRAMS. L. D. Blokhintsev, E. I. Dolinskii, and V. S. Popov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 1636-46(June 1962). (In Russian)

Problems pertaining to the nonrelativistic diagram technique are considered. Assuming constant vertices, a representation of an arbitrary diagram is obtained in the form of an integral over Feynman parameters. The analytic properties of the diagrams as functions of kinematic invariants are discussed. Real singularities of single-contour diagrams are considered, and an explicit expression of the amplitude for a triangular diagram is derived. (auth)

26187 NEW PARTICLES AND THE SAKATA MODEL. I. Yu. Kobzarev and L. B. Okun (Inst. of Theoretical and Experimental Physics, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1651-7(June 1962). (In Russian)

Resonances detected in the interactions of elementary particles are interpreted as bound states in the Sakata model. Predictions are made regarding the possible values of the spin and parity of the new mesons and regarding their charge parity. Consequences following from unitary symmetry of strong interaction are illustrated using the vecton model. (auth)

26188 SCATTERING OF POLARIZED NEUTRONS IN HELICAL MAGNETIC STRUCTURE. Yu. A. Izyumov (Inst. of Metal Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1673-5(June 1962). (In Russian)

Elastic magnetic scattering on a helical structure showed that at the coherent maximum boundary of the basic reflection plane there are two purely magnetic maxima at the same distance from the rotation angle of two adjacent helical spins. An attempt is made to simplify the calculations by using polarized neutron scattering in a case in which all magnetic atoms are identical. It was found that the polarization vector p_m^2 of neutrons scattered in the direction of magnetic peaks is

$$p_m^1 = \frac{\mp 2(em)e + 2M_x(M_x p_0) + 2M_y(M_y p_0) - (M_x^2 + M_y^2)p_0}{1 + (em)^2 \pm 2(em)\,(ep_0)}$$

where the selection of the x and y axis does not affect the expression and the initially nonpolarized neutrons become polarized. The polarization is described by the vector $\mp 2(em)e/[1 + (em^2)]$. With e close to m (m is a pseudovector in the direction of the helix) the spontaneous polarization vector is approximately $\mp m$. It was observed that the polarization vector formula for magnetic elastic scattering is identical to the formula describing the polarization of inelastic magnetic scattering in ferromagnetics. (R.V.J.)

26189 EXPERIMENTAL DATA ON THE EVIDENCE OF RESONANCE IN A $K^0\Lambda^0$ SYSTEM AT 1650 Mev. E. V. Kuznetsov, E. P. Kuznetsov, Ya. Ya. Shalamov, and A. F. Grashin (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1675-7(June 1962). (In Russian)

In Λ^0-K^0 pair production on complex nuclei (C, Cl, F, and Xe) by 2.8 Bev mesons, a certain intermediate state, Z^0,

appears in which Λ^0 and K^0 behave as individual particles. The mass of Z^0 is ~1650 Mev; the lifetime is $\tau_Z > 10^{-22}$ sec. The cross section of Z^0-n interaction is quite large. (R.V.J.)

26190 EVIDENCE OF CHARGE EXCHANGE OF π^- MESONS STOPPED IN BOUND HYDROGEN. A. F. Dunaitsev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1680-2(June 1962). (In Russian)

Charge exchange by 75-Mev π^- mesons passing through a system of scintillation counters and bremsstrahlung filters and stopping in polyethylene or liquid hydrogen targets was recorded. The γ quanta from π^0 decay were recorded with a Cherenkov spectrometer insensitive to background emissions. The signals from the counter and spectrometers were collected in a fast coincidence scheme. The probability ratio for π^0 production is $W_{H_2}/W_{CH_2} = 290 \pm 40$. The statistical order of error is about 5%. The ratio for W_{H_2}/W_{CH_2} indicates an intense π^- capture by carbon nuclei during charge exchange in polyethylene. (R.V.J.)

26191 SPIN STRUCTURE OF AMPLITUDES OF MESON-NUCLEON AND NUCLEON-NUCLEON SCATTERING AT HIGH ENERGIES. V. N. Gribov and I. Ya. Pomeranchuk (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1682-4(June 1962). (In Russian)

The vacuum pole in the amplitudes of meson-nucleon and nucleon-nucleon scattering is analyzed by considering the spin structure and ratio. At $t = 0$ the total cross sections $\sigma_{\pi N}\sigma_{NN} = \sigma^2_{\pi N}$ and $\sigma_{KK}\sigma_{NN} = \sigma^2_{KN}$. The identical ratios serve for elastic scattering average differential cross sections. Polarization is absent in meson-nucleon and nucleon-nucleon scattering at high energies. Spin correlations between nucleon-nucleon and nucleon-antinucleon scattering are also absent. The spin deflection of polarized particles and targets at given t is identical in π-N, K-N, N-N, and N-$\bar{N}$-scattering (including Λ-N). Further verification of the postulation would resolve the concept of moving poles. (R.V.J.)

Neutron Physics

Refer also to abstracts 26504 and 26538.

26192 (AEEW-R-125) THE PREDICTION ON NEUTRON ATTENUATION IN IRON-WATER SHIELDS. A. F. Avery (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Apr. 1962. 69p.

The multigroup method, which was previously used to predict neutron attenuation in water (SWP/P 60), was applied to iron–water systems. Calculations for several shield configurations are presented and the results are compared with the experimental measurements made in the Panel C facility of the LIDO reactor. The accuracy of predictions of reaction rates due to sub-cadmium neutrons is generally to within 50% for penetrations up to 160 cm from the core surface. (auth)

26193 (CEA-2012) MODÉRATION DES NEUTRONS AUX TRÈS BASSES TEMPÉRATURES (thèses). (Neutron Moderation at Very Low Temperatures (thesis)). Albert Lacaze (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). 1962. 99p.

Submitted to Université, Grenoble, France.

Starting from Harwell experiment carried out inside a low-power reactor, it was intended to maintain a liquid H cell in a channel of the EL3 reactor (at Saclay) whose thermal neutrons flux is 10^{14} neutrons/cm^2/s. Attempts were made to work out a device giving off a beam of cold neutrons and able to operate as nearly automatic as possible during many consecutive days without a stop. Several circuits were previously achieved at very low temperatures but they brought out volumes and fluxes much lower than those used this time. The difficulties met in developing such a device arose from the very high energy release to which any kind of experiment is inevitably submitted when placed near the core of the reactor and from the very little room which is available in experimental channels of reactors. In such condition, it is necessary to use a moderator which is as effective as possible. Conditions in which moderation takes place, hence the volume of the cell, were studied along with materials likely to be used at low temperature in pile; and the cooling system fluid flow at very low temperatures in very long ducts. The device is described and results are presented. (auth)

26194 (JAERI-6010) THERMAL NEUTRON ABSORPTION AND SCATTERING CROSS SECTIONS PER UNIT MASS AND UNIT VOLUME; ADDITIONAL VALUES FOR THE DANGER COEFFICIENT PER PPM. S. Otomo and T. Fuketa (Japan Atomic Energy Research Inst., Tokyo). Mar. 1962. 34p.

On the basis of σ_a and $\bar{\sigma}_s$ values taken for BNL-325, 2nd ed. (1958), "Neutron Cross Sections," by D. J. Hughes and R. B. Schwartz the following values were calculated and tabulated: number of atoms per gram, number of atoms per cm^3, thermal neutron absorption cross section σ_a, mean neutron scattering cross section $\bar{\sigma}_s$, the ratio $\sigma_a/\bar{\sigma}_s$, absorption and scattering cross sections per gram and per cm^3, and the danger coefficient per ppm. All elements and a few high-cross compounds were included in the compilation. (TTT)

26195 (KAPL-M-CT-1) WHY—A ONE-DIMENSIONAL FEW-GROUP DIFFUSION CODE FOR THE IBM 1620. R. A. Heffley and C. H. Hunter (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 13, 1962. Contract W-31-109-Eng-52. 67p.

Information is given on the purpose, mathematical method, restrictions, storage requirements, and equipment specifications for WHY. An approximate solution to the diffusion equation is obtained by applying a finite difference equation on a linear mesh for slab, cylindrical, or spherical geometry. WHY, version M for 20K memory, permits at most 3 lethargy groups, 10 different compositions, 20 regions, and 100 space intervals. WHY is written in SPS language in such a way that only minor changes are needed to recompile with different restrictions on the number of regions, materials, and space intervals, as well as the field width of source and flux terms. Arithmetic is fixed point with an input scaling factor for source and flux; rescaling may be done with switch control if necessary. Compile time about 30 min. Running time for a 50-interval, 6-region slab problem is approximately 1 min per iteration with no source extrapolation. (P.C.H.)

26196 (KAPL-M-RPC-3) FICS—A PROGRAM TO COMPUTE FEW-GROUP CONSTANTS WITHIN THE KARE DIFFUSION THEORY SYSTEM. Gordon L. Johns (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 15, 1962. Contract W-31-109-eng-52. 66p.

FICS, which is a group constant program available as an alternative to the WOXX routine within the KARE System is described. FICS computes diffusion constants and macroscopic cross sections for slowing down, absorption, ν-fission, and total removal in two, three, or four energy

groups for each compositional region in the reactor model. One-group thermal constants are provided by a variational technique which computes an approximate Wigner-Wilkins flux spectrum as a linear combination of two trial spectra. These consist of a low-absorption and a high-absorption spectrum, covering the energies below 0.625 ev in 32 lethargy intervals. Thermal group constants are determined by averaging lethargy-dependent microscopic cross sections and diffusion constants over the composite spectrum. FICS' thermal constants are temperature-dependent with region temperatures from 68 to 600°F permitted. In the fast energy range, 10 Mev to 0.625 ev, the program computes temperature-independent constants in one, two, or three energy groups. These are determined from stored microscopic cross sections which were obtained by curve fitting to MUFT parameters over a wide range of metal-water ratios. FICS provides ten optional calculations which can modify the group constants for special purposes. Included are: automatic Xenon determination; special prescriptions for thin, highly absorbing regions; an adjoint option; a technique for handling window shade control rods; and automatic calculation of fission products. (auth)

26197 (NAA-SR-7357) TYCHE, A MONTE CARLO SLOWING DOWN CODE. R. A. Blaine (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 30, 1962. Contract AT(11-1)-GEN-8. 51p.

TYCHE is a Monte Carlo code designed to find the second, fourth, and sixth moments of the neutron slowing down density distribution in an infinite homogeneous medium. Analytic techniques are used to reduce the number of random variables and recursive relations to generate the moments. The code was written in the FORTRAN language for the IBM-7090 computer; typical running time is 5 to 10 minutes for 5000 neutron histories. Cross sections and anisotropic scattering coefficients for ten elements are attached to the deck as a binary library. (auth)

26198 (NP-11859) POLUCHENIE INTENSIVNOGO PUCHKA POLYARIZOVANNYKH TEPLOVYKH NEITRONOV. (Obtaining an Intense Beam of Polarized Thermal Neutrons). A. D. Gul'ko, Yu. A. Oratovskii, and S. S. Trostin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 62p.

An intense beam of polarized thermal neutrons was obtained by reflection in a 1500-mm cobalt magnetic mirror. The flux is 6.1×10^6 n/sec; beam polarization is 91 ± 3%. A new polarization measuring method is described. (tr-auth)

26199 (NP-11932) THE INFLUENCE OF EXTRACTION HOLE ON THE THERMAL NEUTRON SPECTRA. V. G. Molinari (Italy. Comitato Nazionale per l'Energia Nuclear. Laboratorio di Fisica Nuclear Applicata, Rome). May 1962. 17p.

By using the diffusion theory for the cases of strong and no-coupling, the analytical expression for the correction of an extraction hole in the measurement of the neutron spectrum inside a moderator is obtained. Numerical values of this correction are given for water. (auth)

26200 (ORNL-3287) A MONTE CARLO CALCULATION OF SCATTERED NEUTRON FLUXES AT AN AIR-GROUND INTERFACE DUE TO POINT ISOTROPIC SOURCES ON THE INTERFACE. W. E. Kinney (Oak Ridge National Lab., Tenn.). July 30, 1962. Contract W-7405-eng-26. 38p.

Scattered neutron fluxes on the interface between SiO_2 ground and air due to 1- to 19-Mev point isotropic monoenergetic sources located on the interface was calculated by the Monte Carlo method at distances out to 4×10^3 cm from the source. The validity of the method was established by comparing Monte Carlo results for an infinite air medium with moments method results. The two methods were found to yield fluxes that were in good agreement out to 8 source mean free paths for a 2-Mev source. At higher source energies the treatment of inelastic scattering as isotropic elastic scattering overestimated the high-energy flux and underestimated the low-energy flux, while allowing only P_1 anisotropic elastic scattering overestimated the flux near the source and underestimated it far from the source. Scattered neutron fluxes at the interface of black ground and air, which is a useful limiting case, were also calculated. (auth)

26201 (PAN-284/IX) FYNKTSII GRINA TRANSPORTNOGO URAVNEIYA S SINTETICHESKII YADROM. (Green Functions of the Transport Equation with the Synthetic Kernel). Roman Bednakh (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1961. 8p.

For the synthetic kernel model of Skirkov, the solution of the homogeneous equation was found in the case of constant mean free paths. By means of this solution, Green functions for a source in an infinite slowing down medium were obtained. (auth)

26202 (AEC-tr-5077) TWO-GROUP CALCULATION OF CAPTURE GAMMA-RAYS FROM INFINITE SLAB. Noboru Hokkyo and Mitsuyuki Katazume. Translated from Nippon Genshiryoku Gakkaishi, 2: 474-7(1960). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 24997.

26203 (AEC-tr-5145) ELASTIC RESONANCE SCATTERING OF SLOW NEUTRONS IN CRYSTALS. M. V. Kazarnovskii and A. V. Stepanov. Translated from p.97-100 of "Proceedings of the Symposium on the Inelastic Scattering of Neutrons in Solids and Liquids, held in Vienna, October 11-14, 1960." (a publication of the International Atomic Energy Agency, Vienna, 1961.) (STI/PUB/35(p.97-100)). 7p.

A mathematical analysis of the effect of neutron interaction with the crystal lattice on the shape of the line of resonance absorption is presented. It is suggested that an investigation of the resonance scattering of neutrons on various nuclei for which E_0 is less than or of the order of several ev and $\Gamma n/\Gamma \geq 0.1$ can serve as a method of analyzing the dynamic characteristics of crystals. (P.C.H.)

26204 (AEC-tr-5217) USE OF He^3 CHAMBERS IN RECORDING NEUTRON SPECTRA OF FAST REACTORS. A. I. Abramov and M. G. Yutkin. Translated from p.323-8 of "Proceedings of a Symposium on Pile Neutron Research in Physics, held in Vienna, October 17-21, 1960." (a publication of the International Atomic Energy Agency, Vienna, 1962. (STI/PUB/36(p.323-8)). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 18443.

26205 METHODS OF POLARIZATION OF COLD, THERMAL AND RESONANCE NEUTRONS. R. Michalec (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Řež). Československ. časopis pro fysiku, 3A: 272-91 (1962). (In Czech)

Methods for polarizing cold, thermal, and resonance neutrons (i.e., the transmission of neutrons over magnetized ferromagnetic samples, the complete reflection of neutrons from magnetized ferromagnetic mirrors, the diffraction reflection of neutrons from magnetized ferromagnetic single

crystals, the reflection of neutrons from magnetic mirrors, and the transmission of neutrons over polarized samples) are given. (auth)

26206 THE THERMALIZATION AND DIFFUSION OF NEUTRONS IN HEAVY GASEOUS MODERATORS. Satoru Katsuragi (Japan Atomic Energy Research Inst., Tokyo). Nuclear Sci. and Eng., 13: 215-29(July 1962).

The thermalization of neutrons in a finite medium is investigated. The theory is free from the assumption that the energy spectrum is uniform throughout the medium. The flux is composed of several components, each having a definite spectrum and an associated diffusion length, which are to be determined as an eigenmode and a corresponding eigenvalue respectively. It is seen that a particular spectrum (the so-called Hurwitz-Nelkin spectrum) derived under the assumption of flux separability corresponds to the component having the largest diffusion length, which is reached asymptotically in the region far from the source or the boundary. In the case of a noncapturing medium the eigenvalue problem determining diffusion lengths is solved rigorously, and for weak absorbers a perturbation method is developed. It is pointed out that the spectrum in a reactor is constituted by superposing the Hurwitz-Nelkin spectrum upon others having smaller diffusion lengths, the latter being the contribution from the source distributed continuously near the point considered. (auth)

26207 THERMALIZATION AND DIFFUSION PARAMETERS OF NEUTRONS IN ZIRCONIUM HYDRIDE. J. W. Meadows and J. F. Whalen (Argonne National Lab., Ill.). Nuclear Sci. and Eng., 13: 230-6(July 1962).

The pulsed-source method is used to measure the thermal neutron diffusion parameters of Zircaloy-2 hydride, whose approximate composition is $ZrH_{1.7}$. The asymptotic decay constant (zeroth energy eigenvalue) is measured for the buckling range $0.03 < B^2 < 0.39$ cm^{-2} and is fitted by a polynomial containing terms to B^8. The first energy eigenvalue is measured over the range $0.05 < B^2 < 0.39$ cm^{-2} and is used to estimate the thermalization time constant. In addition, the thermalization time constant is also determined from time-dependent transmission measurements with 1/v absorbers. (auth)

26208 THE BEHAVIOR OF EXTRAPOLATION DISTANCES IN DIE-AWAY EXPERIMENTS. E. M. Gelbard and J. A. Davis (Westinghouse Electric Corp., Pittsburgh). Nuclear Sci. and Eng., 13: 237-44(July 1962).

Multigroup extrapolation distances are computed, both in P_3 and diffusion theory, for a number of pulsed moderator systems. Factors that determine the extrapolation distance can be conveniently classified as "multigroup" or "transport" effects. Apparently these effects are separable. Multigroup effects may be treated accurately in diffusion theory, while a one-group model suffices for the analysis of transport effects. (auth)

26209 SCATTERING OF THERMAL NEUTRONS IN THE DOPPLER APPROXIMATION. S. N. Purohit and A. K. Rajagopal (Brookhaven National Lab., Upton, N. Y.). Nuclear Sci. and Eng., 13: 250-60(July 1962). (BNL-5821)

A general mathematical formalism for the energy transfer moments and their associated integrals, which is useful in the study of neutron thermalization, is presented. This formalism is employed to obtain these quantities for the "general Doppler approximation" case, which represents a large number of approximations that belong to the Doppler class. An exact formula for M_2 (the second energy transfer moment weighted by the Maxwellian distribution) is given in terms of binding parameters for the general Doppler case. A Doppler approximation, which satisfies the Detailed Balance theorem and is based upon the Debye-Waller factor and the specific heat integral, is also formulated. A comparative study is undertaken of this approximation and three other Doppler cases (the monatomic-gas-model, the effective-temperature, and the Krieger-Nelkin approximations for rotating molecules) in terms of the validity of the Detailed Balance theorem and the asymptotic scattering behavior. Numerical results based upon the Debye frequency distribution of vibrational modes in the Doppler approximation are presented. (auth)

26210 INFLUENCE OF THE MODERATOR SIZE ON THE SLOWING DOWN OF (D,D) NEUTRONS IN PARAFFIN WAX. B. Grimeland, S. Messelt, and L. Sund (Univ. of Oslo). Nuclear Sci. and Eng., 13: 261-3(July 1962).

Neutrons from a $D(d,n)He^3$ neutron source, operating with 150-kev deuterons, were slowed down in blocks of paraffin wax. The distribution of 1.44-ev neutrons was measured with indium foils in five blocks of various dimensions, all facing the target with one of their end planes. The distribution was approximately the same in all blocks with thickness equal to or larger than 22 cm, which was about four times the slowing-down length in paraffin for (D,D) neutrons slowed down to 1.44 ev. Measurements were also made in a block of dimensions $50 \times 50 \times 100$ cm^3 with the target at the center. The distribution of 1.44-ev neutrons was nearly the same as in the blocks. The slowing-down age for (D,D) neutrons to 1.44 ev in paraffin wax, measured in the direction of the incoming deuteron beam, was found to be (33.0 ± 1.3) cm^3. (auth)

26211 EXPERIMENTAL OBSERVATION OF THE BRAGG MULTIPLE SCATTERING OF NEUTRONS. G. Borgonovi and G. Caglioti (Comitato Nazionale per l'Energia Nucleare, Ispra, Italy). Nuovo cimento, 24: 1174-8(June 16, 1962). (In Italian)

The angular variation of the intensity of neutrons doubly scattered by single crystals of Ni, Al, iron pyrite (FeS_2), LiF, and NaCl is measured. The neutrons are monochromatic, and have wavelengths of 1.29, 1.50, and 2.16 Å. The results are compared with predictions of the theory of double Bragg diffraction of x rays and neutrons. (T.F.H.)

26212 OPTICAL-MODEL FRINGE ABSORPTION AND THE NEUTRON STRENGTH FUNCTION. P. A. Moldauer (Argonne National Lab., Ill.). Phys. Rev. Letters, 9: 17-19(July 1, 1962).

Absorption of s-wave neutrons and angular distribution and polarization of scattered neutrons for nuclear masses at 90 to 120 are explained by assuming that low-energy neutrons are absorbed primarily in the fringe areas about 1 fermi outside the nuclear surface where interactions are less inhibited by the Pauli principle than in the interior of the nucleus. (L.N.N.)

Nuclear Properties and Reactions

Refer also to abstracts 26505, 26506, 26507, 26508, 26509, 26510, 26511, 26512, 26513, 26514, 26515, 26516, 26517, 26518, 26519, 26520, 26521, and 26525.

26213 (AE-78) HALF-LIFE MEASUREMENTS OF ^{6}He, ^{16}N, ^{19}O, ^{20}F, ^{28}Al, ^{77}Se^m AND ^{110}Ag. J. Konijn and S. Malmskog (Aktiebolaget Atomenergi, Stockholm). June 1962. 34p.

The half lives of different isotopes, activated by neutrons in the reactor R2-0 by means of a pneumatic rabbit, were measured with a pulse height analyzer working in its multiscale mode of operation. A NaI(Tl)-scintillation spec-

trometer was used as detector. Least squares analysis calculated by the Mercury computer were performed for each measurement. The following weighted mean values of the half lives were obtained: He^6: 0.862 ± 0.017 sec; N^{16}: 7.31 ± 0.04 sec; O^{19}: 29.1 ± 0.3 sec; F^{20}: 11.56 ± 0.05 sec; Al^{28}: 2.31 ± 0.01 min; Se^{77m}: 18.83 ± 0.04 sec; and Ag^{110}: 24.42 ± 0.14 sec. (auth)

26214 (AERE-M-1035) THE DOPPLER BROADENING OF SLOW NEUTRON RESONANCES. P. A. Egelstaff (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1962. 8p.

A comparison is made of gas and crystal line shapes using the same value of Doppler width. The comparison indicates that the line shape for a crystalline sample is the same as for a gaseous one. By using the same Doppler width for the gaseous calculations, it is possible to describe the line shapes of slow neutron resonances except in extreme cases. Thus, for cases where the absorption coefficient is too great for scattering measurements to be applicable, the use of line shape measurements to deduce the average kinetic energy per nucleus would be useful in the solid or liquid state fields. (N.W.R.)

26215 (AROD-2543.5) THEORETICAL EVALUATION OF THE VARIANCE FOR THE TIME CORRELATION METHOD FOR INVESTIGATING TWO CONNECTED NUCLEAR TRANSFORMATIONS. Final Report, October 1959–October 1960. Wesley O. Doggett (North Carolina State Coll., Raleigh. School of Physical Sciences and Applied Mathematics). Contract DA-01-009-ORD-820. 13p.

The time correlation method provides a means for measuring half lives in the range 10^{-4} to 1 second of daughter activities that are in secular equilibrium with longer lived parent radioactive nuclides. The delayed coincidence technique, which was extremely successful in the 10^{-4} to 10^{-10} second range, cannot be used in the millisecond range because of severe count rate restrictions and the difficulty of achieving the requisite delay circuits. The correlation method consists of dividing the time of an experiment into N intervals of equal length t on the order of the daughter mean life λ^{-1}. At the end of the i^{th} interval, the number of counts a_i detected from the parent radiation in that interval are multiplied electronically by those b_{i+r} from the daughter radiation in the i + r interval. Three scalers accumulate the counts from the parent and daughter channels and the product of the counts for all intervals. The correlation function is computed at the end of the experiment: $\phi(rt) = (1/N)\sum_{i=1}^{N} a_i b_{i+r} - (1/N^2)\sum_{i=1}^{N} a_i \sum_{i=1}^{N} b_{i+r}$. (auth)

26216 (BNL-722) LEAST SQUARES ANALYSIS OF THE 2200 m/sec PARAMETERS OF U^{233}, U^{235}, AND Pu^{239}. Rudolph Sher and Joan Felberbaum (Brookhaven National Lab., Upton, N. Y.). June 1962. Contract [AT(30-2)-GEN-16]. 26p.

An analysis similar to that of Du Mond and Cohen on the atomic constants was applied to measurements of the 2200 m/sec cross sections of U^{233}, U^{235}, and Pu^{239}. The following values are obtained: U^{233}; (σ_T = 591 ± 3), σ_a = 576.1 ± 2.7, σ_f = 527.5 ± 2.4, ν = 2.503 ± 0.010, U^{235}; (σ_T = 694 ± 3), σ_a = 682.0 ± 2.6, σ_f = 582.2 ± 2.2, ν = 2.430 ± 0.009, and Pu^{239}; (σ_T = 1040 ± 10), σ_a = 1030.1 ± 7.4, σ_f = 748.2 ± 4.9, ν = 2.882 ± 0.016. From these values, the following values are derived: U^{233}; η = 2.292 ± 0.008, α = 0.092 ± 0.003, U^{235}; η = 2.074 ± 0.006, α = 0.171 ± 0.003, and Pu^{239}; η = 2.093 ± 0.014, α = 0.377 ± 0.011. The values in parentheses, the σ_T's, are obtained by adding the estimated scattering cross section to the least squares value of σ_a. (auth)

26217 (JINR-E-932) AN INVESTIGATION OF PROPERTIES OF TRANSURANIC ELEMENTS. T. Voros, V. G. Solov'ev (Soloviev), and T. Siklos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 23p.

An investigation based on the superfluid model of a nucleus is described for nuclei in the range 225 ≤ A ≤ 255. The main parameters of the model are chosen from basic experimental data concerning the single-quasi-particle levels of odd nuclei and on the pairing energies, and the probabilities of P-transitions are analyzed with subsequent calculation of the two quasi-particle energy levels of several even-even nuclei. (J.R.D.)

26218 (JINR-P-923) IZUCHENIE TOCHNOSTI METODA BOGOLYUBOVA V TEORII CHETNO-CHETNYKH NESFERICHESKIKH YADER. (On the Precision of Bogolyubov Method in the Theory of Even-Even Non-Spherical Nuclei). A. Pavlikovskii and V. Rybarska (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 30p.

A model was considered (the interaction of n particles with the potential $-G\Sigma_{s,s'} a^{+}_{s} a^{+}_{\bar{s}} a_{\bar{s}'} a_{s'}$, situated on Ω two-fold degenerated equidistant levels). In this case the eigenvalue problem was solved exactly. The results were compared with the calculations by the approximate method of Bogolubov's (u,v) transformation. For the excited states the calculations were made with account of the blocking effect and without it. The method projects the approximate vectors along the sub-space of n particles. The accuracy of the methods applied in investigating the pairing interaction in the even-even nonspherical nuclei is evaluated. (auth)

26219 (JINR-P-942) PEREKHODY OTRITSATEL'NYKH MEZONOV OT VODORODA K YADRAM DRUGIKH ELEMENTOV. (Transition of Negative Mesons from Hydrogen to Nuclei of Other Elements). S. S. Gershtein (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 25p.

It is shown that the large cross section of mesic hydrogen in nuclei with Z > 1 is related to the large number of intersecting molecular terms responding to the charge. Calculations were made of μ-meson transition from mesic hydrogen C and O nuclei, and the problem of cascade transitions to normal C_μ and O_μ was analyzed. It is indicated that the previously observed small cross sections in μ capture from hydrogen by the nuclei are related to the absence of intersecting terms responding to the charge. A rough evaluation was made of the transition cross sections and of π-meson behavior in condensed hydrogen-containing media. (R.V.J.)

26220 (JINR-P-950) OBRAZOVANIE At^{209} I At^{207} PRI BOMBARDIROVKE Bi I Pb PROTONAMI VYSOKIKH ENERGII. (Production of At^{209} and At^{207} by Bombarding Bi and Pb by High Energy Protons). B. N. Belyaev, N. S. Mal'tseva, V. N. Mekhedov, Ming Nam Puk (Min Nam Buk), and R. A. Shimchak (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 10p.

In bombarding bismuth and lead with 120 to 660 Mev protons, the ratios of At^{209}/At^{211} and At^{207}/At^{211} isotope yields were determined. Using chemical methods, the astatine was separated, while the relative yields were obtained from the L particle spectra measured by means of a grid ionization chamber. In irradiating bismuth with 120 to 660 Mev protons the ratio of the At^{209}/At^{211} yields was found to be 0.84 ± 0.06 and 0.72 ± 0.06, while the ratio of the At^{207}/At^{211} yields were 0.30 ± 0.03 and 0.51 ± 0.04. In bombarding lead with 200 and 660 Mev protons, as well as with 400 Mev deuterons the following values of At^{209}/At^{211}

ratio were obtained: 1.31 ± 0.28, 1.43 ± 0.43, and 1.32 ± 0.25. As for the At^{207}/At^{211} ratio, it equals: 0.28 ± 0.07, 0.81 ± 0.13, and 0.52 ± 0.15, respectively. The astatine isotopes are regarded as being produced in the secondary reactions in which the over-Coulomb He^3, He^4, and lithium nuclei due to many particle interactions involving high energy nucleons are captured. The energy spectra of the captured fragments with energies from 20 to 30 up to 100 Mev were determined qualitatively from the calculations of the yields of the observable reactions (α,2n), (α,4n), and (α,6n) on Bi and some reactions from (Li^6,n) to (Li^7,8n) on Pb. The fragment spectra in both cases are very much different from evaporative ones, and for Bi at 120 Mev are best described as $1/E^3$. (auth)

26221 (JINR-P-973) REAKTSII PEREDACHI 2n I 3n PRI OBLUCHENII Al, Cu, Ta IONAMI N^{15} I N^{14}. (Transfer of 2 and 3 Neutrons in Al, Cu, and Ta Bombardment by N^{15} and N^{14} Ions). V. V. Volkov, L. Pomorskii, Ya. Tys, and G. N. Flerov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1962. 18p.

The transfer reactions of two and three neutrons were investigated by bombardment of Al, Cu, and Ta with ions of N^{15} and N^{14}. The thick target yields and cross sections at 50 to 140 Mev were obtained. Cross sections for the transfer of one, two, and three neutrons were compared. (auth)

26222 (LAMS-2642) ENERGY AND TIME DEPENDENCE OF DELAYED GAMMAS FROM FISSION. L. B. Engle and P. C. Fisher (Los Alamos Scientific Lab., N. Mex.). Jan. 1962. Contract W-7405-Eng-36. 41p.

Results are presented of an experiment designed to measure the energy and time dependence of the gammas emitted after effectively instantaneous neutron-induced fission of Th^{232}, U^{233}, U^{235}, U^{238}, and Pu^{239}. Seventeen-bin distributions of the absolute number of photons/fission-sec-Mev and intercomparisons and integrations over energy and time of these distributions are given. Gammas having energies between 0.12 and 6.5 Mev were detected during five short time intervals between 0.2 sec and 45 sec after fission occurred. (auth)

26223 (NAA-SR-7250) POWER AND FLOW RAMP STABILITY TESTS ON THE SRE. C. W. Griffin (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 30, 1962. Contract AT(11-1)-Gen-8. 27p.

The existence of a relatively fast positive power coefficient, with a time constant comparable to that of the fuel Doppler effect (~10 sec) was confirmed by performing negative power ramps and recording the automatic flux-controlled shim-rod motion. Fuel bowing was found to be the cause, and was corrected by restraining the clusters with a helical wrap of stainless steel wire. Individual components of fuel bowing and the isothermal temperature coefficient of fuel and coolant were isolated by conducting a series of power ramps, flow ramps, and combined power and flow ramps. Close coupling between the fuel and coolant prevented separation of these coefficients by this method; but, application of the calculated value for coolant of $\alpha_c = +0.02¢/F°$ gave an experimentally determined value for the fuel of $\alpha_f = -0.23¢/F°$ as compared to a calculated value of $-0.25¢/F°$. Wire wrapping of all of the fuel clusters in the core reduced the power coefficient from +9¢/Mw to −2¢/Mw, showing that the very strong negative Doppler effect had become dominant. This core now has excellent self-regulation due to the strong net negative power coefficient. (auth)

26224 (NP-11865) NUCLEAR ALIGNMENT OF CERIUM-141 IN CERIUM MAGNESIUM NITRATE. Technical Report No. 3. R. C. Sapp and W. W. Strohm, Jr. (Kansas. Univ., Lawrence). July 1, 1962. Contract Nonr 2775(00). 41p.

Nuclear alignment of Ce^{141} was produced by adiabatic demagnetization to very low temperatures of cerium magnesium nitrate, to detect the presence of attenuation due to intermediate state perturbation. At $1/T^* = 150$ the radiation pattern, corrected for counter geometry, is $W(\theta) = 1 + 0.174\ B_2P_2\ (\cos\theta)$. The degree of linear polarization at the same temperature is $P = +0.300 \pm 0.033$. From these data the E2/M1 mixing ratio $\delta = +0.075 \pm 0.013$ and the over-all attenuation coefficient due to spin-spin interaction and to intermediate state perturbation $\lambda_2 Q_2 = +0.97 \pm 0.08$ at this temperature were obtained. Thus attenuation is very much smaller than previously believed. The results are in good agreement with corresponding values for Ce^{141} in the ethylsulfate. At the lowest temperatures the radiation pattern departs strongly from simple behavior, probably due to the onset of a magnetically ordered state. (auth)

26225 (NP-11913) TRANSMISSION AND LINE BROADENING IN MÖSSBAUER EFFECT. [PART] II. S. Margulies, P. Debrunner, and H. Frauenfelder (Illinois. Univ., Urbana). [1961]. 42p.

Calculations expressing the shape of the Mossbauer line to be expected in a transmission-type experiment are extended to the case where both emission and absorption spectra are split by a hyperfine interaction. To see the effects of spectral shape, Gaussian as well as Lorentzian spectra are considered. The results indicate that the characteristics of the transmitted line are strongly dependent upon the spectral shape. To test the calculations, the transmitted lineshape was measured as a function of absorber thickness. These experiments were performed with the 14.4 kev radiation emitted by Fe^{57}. To obtain unsplit spectra, type 310 stainless steel was used for both source backing and absorbers. The observed line was more than four times as wide as the natural width, and was neither Lorentzian nor Gaussian. An unambiguous comparison with the calculation is therefore impossible. Averaging the results of analyses based on the Lorentzian and the Gaussian shape yields $f = 67\%$, $f'_A = 137\%$ for the source and absorber recoilless fractions. Identically split spectra were obtained by using Armco iron for the source backing and the absorbers. In this case, the central resonance line was approximately Lorentzian. Applying the corresponding analysis yields $f = 67\%$, $f'_A = 144\%$. These anomalously high values of f'_A were obtained by using a conversion coefficient of 15. To obtain reasonable values, a conversion coefficient of about 8 is required. (auth)

26226 (NYO-10131) MEASUREMENT OF THE POLARIZATION OF 7-8 Mev PROTONS INELASTICALLY SCATTERED FROM THE FIRST EXCITED STATES OF Ni^{58} AND Ti^{48}. E. E. Griffin and W. Parker Alford (Rochester, N. Y. Univ.). Mar. 6, 1962. Contract AT(30-1)-875. 21p.

The polarization of 7- to 8-Mev protons inelastically scattered to the first excited states of Ni^{58} and Ti^{48} was measured at several angles. Rather large polarizations were observed. At these energies, it is known that both compound nucleus and direct interaction processes contribute to the inelastic scattering, with the former probably most important. Since the conditions of the experiment were such that the statistical compound nucleus model should be applicable, the appearance of polarization probably indicated a failure of the statistical assumption. This conclusion would be more certain if estimates of the polarization to be expected in direct interactions were available. If the observed polarization arose from compound nucleus

processes, then the compound elastic scattering might be expected to be polarized also. Since compound elastic scattering is quite important for even-even nuclei at low energies, this effect might account for the difficulties found in fitting low energy polarization measurements with optical model calculations. (auth)

26227 (ORNL-3251) KINEMATICS II: A NONRELATIVISTIC KINEMATICS FORTRAN PROGRAM TO AID ANALYSIS OF NUCLEAR REACTION ANGULAR DISTRIBUTION DATA. J. B. Ball (Oak Ridge National Lab., Tenn.). July 24, 1962. Contract W-7405-eng-26. 31p.

A FORTRAN program was written for the IBM 709/7090 computer to facilitate the handling of angular distribution data. The program computes, as a function of laboratory angle, the center-of-mass angle of the observed particle, the ratio of the center-of-mass cross section to the laboratory cross section, the laboratory energy of the observed particle, the magnetic rigidity of the observed particle, the laboratory energy of the associated particle, the laboratory angle of the associated particle, the momentum-exchange wave number for the reaction, and the scattering argument (product of the momentum-exchange wave number and the nuclear interaction radius). The program is on file at the Oak Ridge Central Data Processing Facility. (auth)

26228 (PAN-300/VII) DIFFRACTION SCATTERING OF DEUTERONS ON NON-SPHERICAL NUCLEI. II. DEFORMATION OF ARBITRARY MULTIPOLARITY. Janusz Dabrowski and Jerzy Borysowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 13p.

The Drozdov-Blair diffraction scattering model is extended to the case of deuteron scattering on nuclei with surface deformation of an arbitrary multipole order. The structure of the deuteron is taken into account by applying the Achiezer-Sitenko method. Both the universal curve rule and the phase relation of Blair remain approximately valid. The differential cross sections obtained are similar to those obtained with the simple Drozdov-Blair model, provided one diminishes the black nucleus radius R_0 by approximately $\frac{1}{4}$ of the deuteron radius R_d and increases the deformation parameter approximately by the factor $(1 + 3R_d/8R_0)$. (auth)

26229 (PAN-304/VII) ON THE COMPLEX EFFECTIVE MASS IN THE CALCULATION OF THE OPTICAL MODEL POTENTIAL. Janusz Dabrowski and Grzegorz Rohozinski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 8p.

The energy dependence of the imaginary part of the optical potential in the equation for the transition matrix for nucleon-nucleon scattering inside nuclear matter was taken into account by introducing the complex effective mass. The influence of the complex effective mass on the depth of the real part of the optical potential was investigated. A rough estimate shows a decrease in the depth of the real part in the energy range of 100 to 300 Mev. (auth)

26230 (TID-16058) COULOMB EXCITATION WITH HEAVY IONS (thesis). Rogers Charles Ritter (Tennessee. Univ., Knoxville). Aug. 1961. 185p.

A program is described for development of a source of multiply charged heavy ions suitable for use in the ORNL 5.5-Mv Van de Graaff accelerator, and use of this source in studying, by Coulomb excitation, the low lying states of some odd-A nuclei, primarily in the region A = 47 to 75. The character of transitions from Coulomb excitation of 8 odd-A nuclei from Ti^{47} to As^{75} was studied in detail. The angular distribution measurements provided strong evidence for unique spin assignments for 4 of the levels which were excited. Specific observations are included on the relation of the data presented to the shell model and collective aspects of the low energy structure of some of the nuclei. Additional Coulomb excitation with lighter ions or more energetic heavy ions is recommended for these nuclei. (J.R.D.)

26231 (TRG-Report-322) NUCLEAR HEATING OF NON-FISSILE MATERIAL BY THERMAL NEUTRON REACTIONS. A. K. Dickson (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). May 24, 1962. 16p.

The method of calculating the heat generated in non-fissile material in a reactor is described. The reactions considered are (n,γ) and (n,α) and radioactive decay. Tables of the data required to do the calculations are given for the most commonly used materials. (N.W.R.)

26232 (UCRL-9884) BRANCHING RATIOS OF REACTIONS OF π^- MESONS STOPPED IN HYDROGEN AND DEUTERIUM (thesis). James Ryan (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1962. Contract W-7405-eng-48. 103p.

The Panofsky ratio, $P = \omega(\pi^- + p \rightarrow \pi^0 + n)/\omega(\pi^- + p \rightarrow \gamma + n)$, and the branching ratio $S = \omega(\pi^- + d \rightarrow n + n)/\omega(\pi^- + d \rightarrow \gamma + n + n)$, were measured by stopping π^- mesons in liquid hydrogen and liquid deuterium and detecting the gamma rays produced. The values obtained for the branching ratios are: $P = 1.51 \pm 0.04$ and $S = 3.16 \pm 0.10$. The value for P is in agreement with that obtained in previous measurements while the value for S is significantly larger than previous results. With regard to the conventional phenomenological analysis of S-wave pion physics, the Panofsky ratio is in agreement whereas the value obtained for the branching ratio S is considerably larger than predicted. (auth)

26233 (UCRL-10129) SEARCH FOR MULTIPION RESONANCES IN THE REACTION $\bar{p} + p \rightarrow 3\pi^+ + 3\pi^- + n\pi^0$ (thesis). Nguyen-Huu Xuong (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 21, 1962. Contract W-7405-eng-48. 88p.

A study of the reaction $\bar{p} + p \rightarrow 3\pi^+ + 3\pi^- + n\pi^0$ at 1.61 Bev/c (E_{cm} = 2.290 Bev) is reported with the aim of detecting multipion resonances in the final states. The experiment was performed in a 72-inch liquid hydrogen bubble chamber. The total number of 6-prong events in the sample is 715. The events were measured with the Franckenstein measuring projector, and were analyzed by using the PANG, KICK, and EXAMIN programs with IBM 704, 709, and 7090 computers. The cross sections of various processes are found to be $\sigma(\bar{p} + p \rightarrow 3\pi^+ + 3\pi^-) = 1.16 \pm 0.1$ mb, $\sigma(\bar{p} + p \rightarrow 3\pi^+ + 3\pi^- + \pi^0) = 1.8 \pm 0.25$ mb, $\sigma(\bar{p} + p \rightarrow 3\pi^+ + 3\pi^- + 2\pi^0) = 1.05 \pm 0.25$ mb. The angular distributions are symmetrical for all types of events. The existence of the ω meson (T = 0, 3-pion resonance at 780 Mev) is further confirmed. With the hypothesis of G-parity conservation in the decay process (strong decay), the spin and parity of the ω meson is confirmed as 1^{-2} by the Dalitz plot method. Even with the hypothesis of G-parity nonconservation in the decay process (electromagnetic decay), the 1^{-2} spin-pairty assignment is still strongly suggested by the small values of the ratios of $R[(\omega \rightarrow 4\pi)/(\omega \rightarrow \pi^+ \pi^- \pi^0)]$ and $R[(\omega \rightarrow \text{neutral})/(\omega \rightarrow \pi^+ + \pi^- + \pi^0)]$. The neutral four-pion effective mass M_4 distribution shows a suggestive but inconclusive peak at 1.04 Bev. The distribution of the 2-pion effective mass M_2 of the $\bar{p} + p \rightarrow 3\pi^+ + 3\pi^-$ events shows a big difference between $|Q| = 2$ (for like-pion pairs) and $Q = 0$ (for unlike-pion pairs) at the low-value region of M_2. At this

region the M_2 distribution of like pion pairs lies above that from phase-space calculations, and the one of unlike-pion pairs is well below. The ratio $R[(\rho^{\pm} \rightarrow \pi^{\pm} + \eta$ followed by $\eta \rightarrow \pi^+ \pi^- \pi^0)/(\rho^{\pm} \rightarrow \pi^{\pm} \pi^0)]$ is determined to be $1.2 \pm 2.0\%$. This small ratio agrees with a 0^{-+} assignment for spin, parity and G parity of the η meson, but cannot rule out the 1^{-2} possibility. Upper limit of some other decay rates of ρ and ω mesons are presented. (auth)

26234 (NP-tr-885) QUADRUPOLE RADIATION. A. Rubinowicz and J. Blaton. Translated by E. Franklin (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Ergeb. exakt. Naturw., 11: 176-218(1932). 64p.

A review of information concerning quadrupole radiation is presented which includes a discussion of classical theory aspects such as discovery and development of dipole radiation, relations of quadrupole radiation and magnetic dipole radiation, Zeeman effect of the quadrupole lines, and intensities. The older quantum theory is also reviewed in sections on spectral terms designations, correspondence principle and selection rules, metastable states, and natural spectral line width. Other information is presented concerning quantum mechanics in the areas of Zeeman effect of quadrupole lines, normal quadrupole multiplets, intercombination lines, absolute intensities and transition probabilities, forced dipole radiation, and dispersion formula (the f sum rule). (J.R.D.)

26235 RADIATIVE PROTON CAPTURE BY Cr^{50}, Cr^{52}, Cr^{53}, AND Cr^{54}. S. E. Arnell (Univ. of Tech., Goteborg). Arkiv Fysik, 21: 177-83(1962). (In English)

A search for gamma emitting levels in manganese isotopes 51, 53, 54, and 55 was performed by proton bombardment of electromagnetically separated targets of chromium isotopes 50, 52, 53, and 54 in the energy interval 700 to 1400 kev. Nine isolated resonance levels were found in manganese-51, 23 in manganese-53, 44 in manganese-54, and 27 in manganese-55. No obvious evidence of shell effects in the level spacings in the region of neutron number 28 was observed. (auth)

26236 ANGULAR DISTRIBUTION OF GAMMA QUANTA IN THE CAPTURE OF POLARIZED μ^--MESONS BY ATOMIC NUCLEI. F. Janouch and P. Winternitz (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., 12: 331-7(1962). (In English)

The capture of a polarized μ^--meson from the K-orbit of a mesic atom is investigated for the case in which the nucleus, after μ^- capture, is in an excited state and emits a photon of multipolarity L (any type). Angular distributions of circularly polarized photons with respect to the direction of the polarization of the μ^- meson on the K-orbit are obtained for the case of allowed transitions (according to the Morita-Fujii classification). (auth)

26237 INELASTIC SCATTERING FROM ATOMS AT MEDIUM ENERGIES. I. BOUND STATES. Russell A. Bonham (Indiana Univ., Bloomington and Naval Research Lab., Washington, D. C.). J. Chem. Phys., 36: 3260-9 (June 15, 1962).

The problem of computing differential scattering cross sections for the inelastic scattering of 10 to 80 kev electrons from atoms is treated. Expressions for the electron scattering factor for the excitation of bound states of atoms for small excitation energies are presented using the first Born approximation. The scattering factor and differential cross section for argon at 40 kev were calculated neglecting spin and polarization effects. Both Hartree-Fock and Slater central-field wave functions were used in these calculations. Selection rules for electron excitation of bound states of atoms and the behavior of the total inelastic scattering intensity at small scattering angles are discussed. Approximate formulas for the first Born approximation total cross sections were also derived. (auth)

26238 IONIZING COLLISIONS OF METASTABLE HELIUM ATOMS IN GASES. W. P. Sholette and E. E. Muschlitz, Jr. (Univ. of Florida, Gainesville). J. Chem. Phys., 36: 3368-73(June 15, 1962).

Ionization cross sections for collisions of metastable 2^3S and 2^1S He atoms in Ar, Kr, Xe, H_2, O_2, N_2, and CO were measured using a thermal-energy atomic beam in which a fraction of the helium atoms are excited by electron bombardment. Ions produced in these gases by elastic collisions were detected at a metal electrode, and unscattered or elastically scattered metastable atoms were detected by observing the electrons they ejected from metal surfaces. Within the experimental error of the measurements, the cross sections for the triplet and singlet states of helium were the same in all cases except that of H_2. For the rare gases, the results indicated that the size of the struck particle is the primary factor in determining the cross section for ionization, rather than the energy excess. In the case of the diatomic molecules an additional consideration, that of the number and type of ionization processes possible, was also found to be important. (auth)

26239 γ-RAY SPECTRA OF ^{132m}Te AND ^{134}Te. J. M. Ferguson, D. L. Love, and D. Sam (Naval Radiological Defense Lab., San Francisco). J. Inorg. & Nuclear Chem., 24: 1-11(Jan. 1962). (In English)

Tellurium radioisotopes were separated from U^{235} fission products and their γ-ray energies and abundances measured by scintillation techniques. Te^{134} has four γ rays ranging in energy from 79 to 262 kev. An equilibrium mixture of Te^{132m} and Te^{132} has eleven γ rays ranging in energy from 309 to 973 kev. A partial decay scheme for Te^{132m} is proposed. The half periods of Te^{132m} and Te^{134} were remeasured as 50 and 42 min, respectively. (auth)

26240 YIELD RATIOS FOR THE ISOMERIC PAIR ^{121m}Te, ^{121}Te PRODUCED IN ^{121}Sb(d,2n)^{121}Te NUCLEAR REACTION. S. J. Nassiff, S. Abecasis, and A. Mocoroa (Comision Nacional de Energia Atomica, Buenos Aires and Universidad Nacional de la Plata, La Plata). J. Inorg. & Nuclear Chem., 24: 113-16(Feb. 1962). (In English)

The cross-section ratio for the isomeric pair Te^{121m}, Te^{121} produced in the $Sb^{121}(d,2n)Te^{121}$ nuclear reaction was determined experimentally for deuterons from 9 to 28 Mev. (auth)

26241 THE VALUE OF η FOR ^{238}U WITH NEUTRONS OF ENERGY BETWEEN 12 Mev AND 19 Mev. P. H. White (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 16: 261-73(May 1962).

The number of neutrons per inelastic collision η was measured for uranium with incident neutrons in the energy range 12 to 19 Mev. Over this range η was found to increase from approximately 2.6 to 4.3. The value found at 14 Mev was 3.22 ± 0.12 which agrees with previous measurements. The technique used was to measure the neutron multiplication of shells of uranium when placed around the detector. The detector employed was a gas scintillation fission counter containing U^{235}, U^{238}, or Pu^{239} as the fissile material. At 14 Mev the multiplication measurements were obtained both with a shell around the counter and also

with a shell around the neutron source in order to find the mean transport cross section for the inelastic neutrons. This was found to be 5.2 ± 0.6 barns. Values of the cross sections for the (n,3n) and (n,4n) reactions were deduced and compared with the predictions of statistical theory. (auth)

26242 THE GAMMA-RAY DISTRIBUTION FROM ORIENTED CERIUM-141. J. F. Schooley, D. D. Hoppes, and A. T. Hirshfeld. J. Research Natl. Bur. Standards, 66A: 317-20(July-Aug. 1962).

The distribution of gamma-radiation emitted in the decay of Ce^{141} nuclei alined in neodymium ethylsulfate single crystals was remeasured for temperatures as low as 0.0162°K and was found to be considerably more anisotropic than previously thought. The discrepancy is explained on the basis of preferential scattering of the plane-polarized radiation in the Dewar system. Similar measurements with Ce^{141} nuclei oriented in a polarized cerium ethylsulfate crystal were made. The hyperfine constant for Ce^{141} in the neodymium ethylsulfate lattice is deduced as A = 0.0305 ± 0.003 cm^{-1}, and the E2/M1 ratio for the 145-kev gamma ray in Pr^{141} is +0.068 ± 0.008. (auth)

26243 RANGES OF RECOIL IONS FROM α-REACTIONS. Lise Bryde, N. O. Lassen, and N. O. Roy Poulsen. Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd., 33: 1-28 (1962). (In English)

The recoil Ga^{66} ions, produced in (α,n) reactions when a thin copper layer is bombarded by α particles from the cyclotron, are stopped in a pure gas. The thermalized ions are collected by means of an electric field, and from measurements of the activity distribution on the collector electrode the range distribution is obtained. In each gas, H_2, D_2, He, N_2, or Ar, the mean range is found to be nearly proportional to the energy E in the interval 0.6 Mev < E < 1.2 Mev, in agreement with a theoretical formula. In this energy interval both electronic and nuclear stopping are of importance. The reliability of the method is discussed. The shape of the range distribution in H_2 is compared with the calculated shape to be expected as a result of neutron emission from the compound nuclei, and from the half widths in various gas estimates of the straggling are obtained. In a special experiment the range of Ga^{66} ions in copper is estimated. In other measurements, the ranges of potassium ions in argon and F^{18} ions in nitrogen are obtained by the collector method. Gallium and potassium ions are found to be positive when thermalized, whereas F^{18} ions in nitrogen are found to be predominantly negative. (auth)

26244 HALF-LIVES OF CARBON-10 AND NEON-19. L. G. Earwaker, J. G. Jenkin, and E. W. Titterton (Australian National Univ., Canberra). Nature, 195: 271-2(July 21, 1962).

Half lives of C^{10} and Ne^{19} were measured by observing the β^+ decay from (p,n) reactions on B^{10} and F^{19}. They were determined to be 19.48 ± 0.05 sec for C^{10} and 17.43 ± 0.06 sec for Ne^{19}. (D.L.C.)

26245 ENERGY AND ANGULAR DISTRIBUTION OF ALPHA PARTICLES FROM THE $Na^{23}(n,\alpha)F^{20}$ REACTION INDUCED BY 14 Mev NEUTRONS. O. N. Kaul (Saha Inst. of Nuclear Physics, Calcutta). Nuclear Phys., 33: 177-81 (May 1962). (In English)

Alpha particles produced by the interaction of 14-Mev neutrons with sodium are studied with the help of Ilford 200-μm nuclear emulsion plates. The energy distributions of the alpha particles agree with predictions of evaporation theory. The angular distributions are consistent with compound nucleus formation in the sense that they show a symmetry about 90°. The relative level density calculated from the energy distribution of the alpha particles fits exactly a straight line corresponding to a Maxwellian distribution with a temperature of 1.55 Mev. The total (n,α) cross section is estimated to be 185 mb ± 15%. (auth)

26246 DIRECTIONAL CORRELATION MEASUREMENTS IN XENON-132. M. Narayana Rao (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 33: 182-93(May 1962). (In English)

The directional correlations of six different gamma cascades involving the levels at 670, 1443, 1960, 2400, 2630, and 2840 kev are studied. By a comparison of the experimental coefficients obtained by least squares analysis of the data with theoretical coefficients for various possible sequences, the spins of these levels and the mixing ratios of the transitions involving these levels are determined. The proposed spins are 1443 (4), 1960 (3 or 4), 2400 (4), 2630 (3), and 2840 (3). The spin assignment of 3 for the 2630-kev level strengthens the suggestion that this level is of octupole vibrational origin. (auth)

26247 THE MISSING J = 5/2 STATE OF ^{7}Li. A. B. Clegg (Clarendon Lab., Oxford). Nuclear Phys., 33: 194-7 (May 1962). (In English)

The relationship between the intermediate-coupling shell model, the cluster model, and the unified model of 1p-shell nuclei are discussed. In particular the J = 5/2 state of Li^7 predicted by the intermediate-coupling shell model, which is not observed experimentally, is identified with a state of the cluster model and with a state of the ground state rotational band of the unified model. This latter identification suggests an experiment to observe this state. (auth)

26248 GAMMA RAY YIELDS FROM THE PROTON BOMBARDMENT OF B^{10}. T. R. Ophel, R. N. Glover, and E. W. Titterton (Australian National Univ., Canberra). Nuclear Phys., 33: 198-201(May 1962). (In English)

Measurements of the excitation functions of the $B^{10}(p,\alpha\gamma)$, $B^{10}(p,p'\gamma)$, and $B^{10}(p,\gamma_0)$ reactions within the proton energy range of 2.4 to 7.2 Mev establish levels in C^{11} at excitation energies of 11.45 ± 0.01, 12.66 ± 0.01, and 13.91 ± 0.02 Mev. (auth)

26249 STUDY OF THE REACTION $C^{12}(Li^6,\alpha)N^{14}$. Pham-Dinh-Lien and L. Marquez (Centre d'Études Nucléaires, Saclay, France). Nuclear Phys., 33: 202-7(May 1962). (In French)

The angular distribution of the alpha particles corresponding to the ground state and second excited state from the reaction $C^{12}(Li^6,\alpha)N^{14}$ is measured. The results can be interpreted in terms of the stripping theory if the heavy particle stripping is included. (auth)

26250 THE EFFECT OF STATISTICAL PERTURBATIONS ON ANGULAR CORRELATIONS. Darcy Dillenburg and Th. A. J. Maris (Universidade do Rio Grande do Sul, Pôrto Alegre, Brazil). Nuclear Phys., 33: 208-17(May 1962). (In English)

The influence of an arbitrary statistical interaction, which is random in space, on the angular correlation of two particles successively emitted by a nucleus is investigated. The resulting time-dependent angular correlation function has the form $c_0 + \Sigma_i c_i f_i(\theta) e^{\lambda_i t}$, in which the $f_i(\theta)$ represent characteristic angular distributions given by the properties of the interaction in the source and by the type of particle emitted in the second decay. Some special cases are considered. If, for example, the statistical interaction consists of small electric quadrupole and magnetic dipole perturbations and the second particle is a photon, the $f_i(\theta)$ become identical to Legendre polynomials. Sufficiently ac-

curate measurements of the characteristic angular distributions and decay constants gives information on the mechanism of the spin relaxation by the statistical interaction in the source. (auth)

26251 VELOCITY DEPENDENT NUCLEAR FORCES AND THEIR EFFECT IN NUCLEAR MATTER. A. M. Green (Univ. of Birmingham, Eng.). Nuclear Phys., 33: 218-35(May 1962). (In English)

An investigation is made as to whether it is possible to replace the hard core in nucleon-nucleon potentials by a non-singular but strongly velocity-dependent potential. This proposition is considered in two stages. Firstly, such a non-singular velocity-dependent potential is adjusted to fit the experimental phase-shifts in the four states singlet, even and odd, and triplet, even and odd. The results show that a rough fit can be obtained comparable to the Gammel-Thaler fit with hard-core potentials. These data therefore do not offer a sensitive method of distinguishing the two types of potential. Secondly, the potentials so obtained are used to calculate the energy of infinite nuclear matter by applying ordinary perturbation theory. With first-order perturbation theory it is possible to get saturation at densities in the neighborhood of the experimental value, but with an energy that is too positive. However, it is shown that the next term in the series, which is always negative, is by no means negligible, and so must also be considered, if an accurate value of the energy is required. These terms are sufficiently small as to indicate reasonable convergence of the series. (auth)

26252 INELASTIC (n-p) CROSS SECTION AT 30 Gev. G. Bozóki, E. Fenyves, and L. Jánossy (Central Research Inst. of Physics, Budapest). Nuclear Phys., 33: 236-8(May 1962). (In English)

The inelastic n-p cross section (σ_{n-p}) was determined from the attenuation of penetrating shower-producing cosmic ray neutrons in paraffin and graphite by the CH_2-C subtraction method as $\sigma_{n-p} = (35 \pm 11)$ mb. The collision mean free path was found to be (73 ± 7) g/cm^2 in graphite and (68 ± 5) g/cm^2 in paraffin. The mean energy of neutrons was estimated to be about 30 Bev. (auth)

26253 THE GIANT E1 RESONANCE FOR DEFORMED NUCLEI. S. G. Nilsson, J. Sawicki, and N. K. Glendenning (Univ. of California, Berkeley). Nuclear Phys., 33: 239-60(May 1962). (UCRL-9803). (In English)

The random-phase approximation is applied to the giant E1 resonance of the deformed nucleus Mg^{24}. Two well separated peaks are predicted on the basis of reasonable force parameters. The backward-going graphs are found not to affect significantly the positions of the 1^- states or the relative distribution of the oscillator strength. On the other hand the Thomas-Kuhn-Reiche (TKR) sum is diminished for the case of a Ferrell-Visscher force by a magnitude of up to 30% by the inclusion of ground state correlations. The violation of the TKR sum rule encountered in the shell-model calculations is thus reduced considerably. (auth)

26254 NUCLEAR ISOMERS PRODUCED BY REACTOR NEUTRONS. P. F. Fettweis and E. C. Campbell (Centre d'Etude de l'Energie Nucléaire, Mol, Belgium). Nuclear Phys., 33: 272-84(May 1962). (In English)

Short-lived isomers are produced in a reactor, using a fast pneumatic transfer tube. Decay schemes are proposed and discussed for the isomeric levels in the odd nuclei Na^{24}, Ga^{72}, In^{116}, and Ir^{194}, and in the deformed nuclei Yb^{169}, Yb^{175}, Yb^{177}, and Hf^{179}. (auth)

26255 A MEASUREMENT OF β^- AND EC BRANCHING RATIOS IN THE DECAY OF 8.15-h Ta^{180} AND A SEARCH FOR THE β^- DECAY OF Hf^{180m}. C. J. Gallagher, Jr., M. Joergensen, and O. Skilbreid (Univ. of Copenhagen). Nuclear Phys., 33: 285-93(May 1962). (In English)

The decay of the 8.15-hr Ta^{180} isomer is studied, and it is found that the β^-/EC branching ratio is 0.15 ± 0.02, the ratio of β^- branching to the 0+ and 2+ levels in W^{180} is 3.00 ± 0.45, the ratio of EC branching to the 0+ and 2+ levels in Hf^{180} is 2.20 ± 0.33, and E_{β^-} (max) is 710 ± 15 kev for decay to the W^{180} ground state. The observed branching ratios are within experimental error of the theoretical branching ratios, assuming K = 1 for the Ta^{180} isomer. A lower limit is set on the intensity of a β^- group depopulating the 5.5-hr Hf^{180m}. An interpretation of the intrinsic structure of the Ta^{180} isomers is discussed. (auth)

26256 GAMMA-GAMMA DIRECTIONAL CORRELATION IN Ti^{46}. P. C. Lall and Larry Schecter (Oregon State Univ., Corvallis). Nuclear Phys., 33: 294-6(May 1962). (In English)

The directional correlation between the 1.119-Mev gamma ray and the 0.885-Mev gamma ray in the de-excitation of excited Ti^{46} is measured in an effort to strengthen the spin and parity assignment of the 2.004-Mev state, and to try to determine the mixing ratio of multipolarities in the upper transition. The data yield a least-squares solid-angle-corrected correlation function $W(\theta) = 1 + (0.1049 \pm 0.0020)\, P_2(\cos\theta) + (0.0057 \pm 0.0030)\, P_4(\cos\theta)$. This result is consistent with the assignment (4+) for the 2.004-Mev state and the inclusion of at most $(0.005\% \pm 0.002\%)$ M3 radiation mixed with pure E2 radiation in the 1.119-Mev gamma ray. (auth)

26257 A DETERMINATION OF THE MEAN L-FLUORESCENCE YIELD IN THALLIUM. M. K. Ramaswamy (Ohio State Univ., Columbus). Nuclear Phys., 33: 320-2 (May 1962). (In English)

Using a Hg^{203} source, the mean L-fluorescence yield in thallium is determined to be 0.41 ± 0.04 by comparing the L and K x-ray intensities following the conversion of the 279-kev gamma ray in Tl^{203}. (auth)

26258 THE (p,d) REACTION AT MEDIUM ENERGIES. P. Gould (Univ. of Birmingham, Eng.). Nuclear Phys., 33: 336-46(May 1962). (In English)

The (p,d) pickup reaction is examined as an alternative to the (p,2p) reaction for the investigation of filled shell model states. A theoretical analysis following Butler theory is outlined and, assuming bound state energies calculated from a realistic potential, angular distributions and deuteron energy spectra are obtained for (p,d) reactions on Ni^{58} and Ca^{40}. (auth)

26259 A PRECISION MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF BETAS FOLLOWING P^{32} DECAY. A. R. Brosi, A. I. Galonsky, B. H. Ketelle, and H. B. Willard (Oak Ridge National Lab., Tenn.). Nuclear Phys., 33: 353-87(May 1962). (In English)

The method of Mott scattering is used to determine the longitudinal polarization of 616-kev betas from the allowed Gamow-Teller decay of P^{32}. After rotation of the spin from longitudinal to transverse by a spherical electrostatic analyzer, the up-down asymmetry is measured over a wide range of gold target thickness. Source depolarization, plane scattering depolarization, multiple and plural scattering in gold and aluminum targets, and instrumental asymmetry effects are investigated experimentally. Corrections are made for various backgrounds, wall scattering, finite geometry, and fringing fields. The final value of $P = (-0.990 \pm 0.009)v/c$ for $v/c = 0.891$ depends upon the calculated value of the Mott-scattering function $S(\theta)$, which is not corrected for screening, inelastic scattering, Schwinger re-

diative loss, or finite nuclear size effects. These are estimated to be the order of 2% or less. Neglecting these effects and small theoretical corrections to the polarization resulting from such effects as Δl-forbiddenness and finite nuclear size, this experimental result can be interpreted in terms of the beta-decay coupling constants. If time reversal invariance and the two-component neutrino theory are assumed, the ratio $C_T/C_A = 0.011 \pm 0.010$ is computed from the measured polarization. On the other hand, assuming time reversal invariance and $C_T = C_T' = 0$, then the ratio C_A'/C_A is limited to the range +0.82 to +1.22 by the experimental result. (auth)

26260 PION PRODUCTION BY PROTON BOMBARDMENT OF He^3 AND H^3 NEAR THRESHOLD. S. F. Edwards and A. D. Kanaris (Univ. of Manchester, Eng.). Nuclear Phys., 33: 388-400(May 1962). (In English)

The reactions $p + He^3 \rightarrow He^4 + \pi^+$ and $p + H^3 \rightarrow He^4 + \pi^0$ are investigated near threshold, where only s-wave pions are involved. Assuming that the incident pion interacts only with one nucleon in the target at a time, the expression for the transition matrix element is derived. The total cross sections are computed to be 2.6 μb, and the general features of the results discussed. The approximations used are analyzed and their effect on the results estimated. The two reactions are discussed from the point of view of charge independence. (auth)

26261 THE PHOTODISINTEGRATION OF BISMUTH AND THE LEAD ISOTOPES. E. G. Fuller and Evans Hayward (National Bureau of Standards, Washington, D. C.). Nuclear Phys., 33: 431-48(May 1962). (In English)

The photodisintegration of bismuth and the lead isotopes is studied by measuring the neutron emission cross sections. The lead targets are enriched in Pb^{206}, Pb^{207}, and Pb^{208}. The cross sections obtained for all four isotopes are very similar. They peak near 13.8 Mev, have cross sections integrated to 18.5 Mev of 3.93 Mev × b and display some structure. The structure is shown to agree with the results of calculation. Below the (γ,n) threshold the elastic scattering cross sections are measured for lead, radio-lead, and bismuth. Self-absorption experiments are also performed. The analysis of these data shows that the participating levels have widths of a few volts. An experiment at liquid nitrogen temperature indicated that the levels in Pb^{206} are narrower than those in the other two target materials. (auth)

26262 THE $Li^7(p,\alpha)\alpha$ REACTION. Y. Cassagnou (Centre d'Études Nucléaires, Saclay, France), J. M. F. Jeronymo, G. S. Mani, A. Sadeghi, and P. D. Forsyth. Nuclear Phys., 33: 449-57(May 1962). (In English)

The $Li^7(p,\alpha)\alpha$ reaction is studied up to 4.8 Mev proton energy. The angular distribution is fitted to a polynomial of the form $C(E)(1 + A(E)\cos^2\theta + B(E)\cos^4\theta)$. The coefficients A(E) and B(E) show enormous variation above 4.0 Mev proton energy. The results are discussed in terms of levels in Be^8. The results indicate also the presence of direct interaction. (auth)

26263 ELASTIC SCATTERING OF POLARIZED PROTONS BY C^{12}. L. Rosen (Los Alamos Scientific Lab., N. Mex.), P. Darriulat, H. Faraggi, and A. Garin. Nuclear Phys., 33: 458-67(May 1962). (In English)

The angular dependence of the polarization resulting from the elastic scattering of protons by C^{12} is measured for 8 proton energies between 5.4 and 19.7 Mev. An optical model analysis is performed and is able to reproduce the experimental results except for two energy regions, around 10 and 20 Mev. Inelastic scattering polarization is also obtained at 19.7 Mev for the first C^{12} excited level at 4.4 Mev. (auth)

26264 THE GAMMA SPECTRUM OF TERBIUM-160 BELOW 1 Mev. D. G. Douglas (Univ. of Manitoba, Winnipeg, Can.). Nuclear Phys., 33: 485-93(May 1962). (In English)

The gamma spectrum of terbium-160 below 1 Mev is studied by means of a curved crystal spectrometer. Gamma rays of the following energies, expressed in kev, are observed: 966, 880, 764 (1.9), 681 (0.7), 394 (1.3), 338 (0.3), 310 (0.9), 298, 230 (0.07), 215, 197, 94 (0.06), and 87. The numbers in brackets are the relative photon intensities for weak lines based on values for the corresponding numbers for the strong lines. By comparison of a 2nd order gamma line with K x ray lines the energy values 86.75 ± 0.03 and 93.91 ± 0.05 kev are obtained for 2 of the gamma rays. Evidence is presented for assigning the multipolarity E1 to the 230-, 310-, and 338-kev transitions and E2 to the 93.9-kev transition. (auth)

26265 ENERGY LEVELS OF B^{10}. I. THE REACTIONS $B^{10}(p,p')B^{10}$, $B^{10}(d,d')B^{10}$ AND $C^{12}(d,\alpha)B^{10}$. B. H. Armitage (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and R. E. Meads. Nuclear Phys., 33: 494-501(May 1962). (In English)

Levels in B^{10} excited by proton inelastic scattering with 10.02-Mev protons included two at 1.74 and 5.16 Mev. These levels were not excited in a deuteron inelastic scattering experiment, however, indicating that T = 1 for both the 1.74- and 5.16-Mev levels. The upper limit to the relative intensity of the 5.16-Mev group was 1.5% of the average intensity of the T = 0 groups observed at 60° when the deuteron bombarding energy was 10.04 Mev. This result was confirmed by a study of the $C^{12}(d,\alpha)B^{10}$ reaction, in which the 1.74- and 5.16-Mev levels in B^{10} were found not to be excited. (auth)

26266 ENERGY LEVELS OF B^{10}. II. THE $Be^9(p,\gamma)$ REACTION. R. E. Meads and J. E. G. McIldowie (Clarendon Lab., Oxford). Nuclear Phys., 33: 502-15(May 1962). (In English)

Accurate energy measurement of the γ ray establishes that a transition of ≈ 2.4 Mev energy observed at the E_p = 1086 kev resonance in the $Be^9(p,\gamma)B^{10}$ reaction takes place between the 7.56-Mev state and the upper member of the doublet of levels at 5.11 and 5.16 Mev in B^{10}. A survey of the γ rays excited in the $Be^9(p,\gamma)$ reaction between E_p = 800 and 1130 kev is made using a three crystal pair spectrometer and reveals no unpredicted resonance structure. The γ width of the 7.56-Mev state in B^{10} is measured and a result $(2J + 1)\Gamma\gamma = (6.6 \pm 1.5)$ ev obtained. The relevance of these and other measurements to the state of knowledge concerning levels in B^{10} between 5 and 8 Mev is discussed, in particular to the problem of deciding which of the known levels is the isobaric spin analog of the 3.37-Mev $J^\pi = 2^+$, T = 1 state in Be^{10}. (auth)

26267 CIRCULAR POLARIZATION OF γ-QUANTA PRODUCED BY THE REACTION $B^{10}(d,p)B^{11}$. J. Zimányi, J. Eroe, L. Pócs, and I. Szentpétery (Central Research Inst. for Physics, Budapest). Nuclear Phys., 33: 524-8 (May 1962). (In English)

The circular polarization of the 4.46-Mev γ rays, emitted in coincidence with protons emitted at 75° with respect to the deuteron beam, is measured in the $B^{10}(d,p)B^{11}$ reaction. At 0.45 Mev deuteron energy the polarization is found to be (30 ± 11)%. Calculations are made to determine the polarization of the angular momentum of the captured neutrons and to predict the polarization of the protons on the basis of "Central Force Distorted Wave Direct Interaction" model. (auth)

26268 SOME ACTIVATION CROSS SECTIONS FOR 14.7 Mev NEUTRONS. J. Kantele and D. G. Gardner (Univ. of Arkansas, Fayetteville). Nuclear Phys., 35: 353-62(June 1962). (In English)

Some activation cross sections of B, O, F, Al, P, and Cu for 14.7-Mev neutrons are compared using both beta- and gamma-ray detection techniques, and the absolute values computed with the aid of the Cu^{63} and Cu^{65} (n, 2n)-reaction cross section values. The Al^{27} (n, p) cross section is shown not to vary significantly as a function of neutron energy near 14 Mev. The importance of an order-of-magnitude check of cross section values with gamma detection, whenever possible, is pointed out. Some details of cross section determination techniques are demonstrated and discussed. (auth)

26269 THE EFFECT OF COLLECTIVE EXCITATIONS ON THE SINGLE PARTICLE SPECTRA OF NUCLEI. J. R. Schrieffer (Univ. of Illinois, Urbana). Nuclear Phys., 35: 363-9(June 1962). (In English)

In deriving the collective-excitation spectra of nuclei it is often assumed that the collective modes have negligible effect on the quasi-particle spectrum. An expression is derived for the self-energy of the quasi-particle states, including pairing interactions as well as virtual excitation of collective modes, from which the validity of the assumption in question can be investigated. (auth)

26270 TEST OF AN APPROXIMATION METHOD FOR BREAKUP REACTIONS. L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nuclear Phys., 35: 370-81 (June 1962). (In English)

A model of a breakup reaction is treated in terms of a particular formalism. Three approximations within this formalism are discussed, and all are found to yield more accurate results than the Born and impulse approximation. In particular, the formalism gives the correct analytic behavior for the cross sections and energy spectrum near the inelastic threshold; this is an energy region where other methods fail completely. The behavior of successive terms in the expansion used for the breakup wave function is also discussed; the expansion converges for all energies, and for a large region near threshold only one or two terms need be kept. (auth)

26271 COLLECTIVE-E3 AND E4 TRANSITIONS IN SPHERICAL NUCLEI AND THE EFFECTIVE CHARGE. Taro Tamura and Takeshi Udagawa (Tokyo Univ.). Nuclear Phys., 35: 382-92(June 1962). (In English)

Properties of the nuclear collective 3^- and 4^+ states, obtained from the inelastic scattering of very high energy electrons, are discussed within the framework of the Bardeen-Cooper-Schrieffer and Sawada approximations. It is shown that the experimental data are accounted for quite well by taking reasonable values for the parameters used in the calculation. A discussion is given of the evaluation of the effective charge that appears in the expression of the transition probabilities. (auth)

26272 Be^9 IN THE CLUSTER MODEL. Y. C. Tang, F. C. Khanna, R. C. Herndon, and K. Wildermuth (Florida State Univ., Tallahassee). Nuclear Phys., 35: 421-33(June 1962). (In English)

Low-lying levels of Be^9 are examined in the neutron-plus-Be^8 cluster configuration. The purpose of this study is to determine the nature of the anomaly existing at about 1.7 Mev. The results indicate that this anomaly is a resonant state with spin and parity $\frac{1}{2}-$. The energy of the $\frac{3}{2}-$ ground state is also computed. The calculated value of −59.1 Mev compares favorably with the experimental value of −58.2 Mev. (auth)

26273 QUASI-ELASTIC PROTON SCATTERING ON Li^7 AND C^{12}. J. Strnad (Univ. of Ljubljana, Yugoslavia). Nuclear Phys., 35: 451-4(June 1962). (In English)

The momentum distribution for protons in nuclei is calculated using a simple shell model with a square-well potential, and compared with experimental data from quasi-elastic scattering on Li^7 and C^{12}. (auth)

26274 NUCLEAR CROSS SECTIONS AT HIGH ENERGIES. N. R. Steenberg (Univ. of Toronto). Nuclear Phys., 35: 455-71(June 1962). (In English)

For protons in the Bev region the dependence of the absorption cross section $\sigma_a(A)$ on the mass number A of the target is close to the geometric value. However, account must be taken of the granular nature of nuclear matter. An optical-type model is proposed to describe the absorption by a target comprising a moderate number of absorbers of finite size confined to a fixed volume. Because of the exclusion of volume by an individual absorber there results a more rapid attenuation than that normally assumed. The cross section can be represented by a simple formula $\sigma_a(A) = \sigma_a(1)A^n$, where $\frac{2}{3} \leq n \leq 1$, which is consistent with the experimental data. The model is extended to the total and scattering cross sections. (auth)

26275 NUCLEAR RESONANCE SCATTERING OF BREMSSTRAHLUNG. E. C. Booth (Boston Univ.) and Kenneth A. Wright. Nuclear Phys., 35: 472-84(June 1962). (In English)

Forty excited states of light nuclei were investigated. Resonance fluorescence was observed. Mean lifetimes or lower limits were calculated for all observed cases. (auth)

26276 SHELL MODEL STUDY OF Li^6 WITH THE GAMMEL AND THALER TWO NUCLEON POTENTIAL. Natalia Meshkov (Univ. of Pennsylvania, Philadelphia). Nuclear Phys., 35: 485-507(June 1962). (In English)

An intermediate-coupling shell model calculation is carried out on the energy spectrum of the Li^6 nucleus using the Gammel and Thaler (GT) potential for the two-nucleon interactions. The effect of the repulsive core is calculated using a perturbation method. A comparison of the calculated and the experimental levels of Li^6 shows that the energies arising from the singlet-even and triplet-odd GT potentials are in agreement with experiment, while a large discrepancy with experiment arises from the triplet-even central GT potential. In view of the uncertainty in the GT triplet-even potential parameters, a modification of these parameters is introduced such that a fit to the Li^6 spectrum is obtained, leaving all the other GT potential parameters unchanged. In addition, the quadrupole moment of Li^6 calculated with the modified GT potential is in agreement with the experimental value. The modified potential is quite similar to the effective potentials of other shell model studies. The spin-orbit force in a nucleus, which is necessary to explain a large number of nuclear properties, is found to arise from the triplet-odd GT spin-orbit potential. (auth)

26277 DESCRIPTION OF COLLECTIVE NUCLEAR VIBRATIONS USING SHELL MODEL WAVE FUNCTIONS. B. J. Verhaar (Universiteit, Amsterdam). Nuclear Phys., 529-43(July 1962). (In English)

An investigation is made of collective vibrations of a system of nucleons moving in a harmonic oscillator potential. For some modes of vibration, collective coordinates and conjugate momenta are introduced. It is shown that the Schrödinger equation of the system separates into two wave equations, of which one describes the collective motion and the second contains only variables of the remaining degrees of freedom. Making use of the results obtained for this sys-

tem, some aspects of the unified model and the generator method are discussed. (auth)

26278 ON THE COLLECTIVE QUADRUPOLE STATE OF C^{12}. A. Goswami (Saha Inst. of Nuclear Phys., Calcutta) and M. K. Pal. Nuclear Phys., 35: 544-56(July 1962). (In English)

A configuration-mixing calculation is carried out for the 4.43-Mev, 2^+ state of C^{12}. The hole-particle pairing interaction is treated on a model where the matrix elements consist of two factorable terms, one of them representing no spin flip, and the other representing spin flip. The quadrupole transition probability is calculated with and without ground state correlations. It is concluded that ground state correlations are important in C^{12} and responsible for the observed enhancement of the transition rate of the quadrupole level. (auth)

26279 HIGH ENERGY INELASTIC PROTON SCATTERING ON CARBON. E. A. Sanderson (Univ. of Copenhagen). Nuclear Phys., 35: 557-70(July 1962). (In English)

Differential cross sections for the scattering of 180-Mev protons leaving the C^{12} nucleus in 1^-, 2^-, 3^-, and 1^+ excited states are calculated, using the impulse approximation. A purely absorptive optical potential, in the semi-classical approximation, is used to describe distortion effects. The particle-hole interaction description of the excited states is exploited. (auth)

26280 EXCITED STATES OF Ag^{107}. N. L. Lark, P. F. A. Goudsmit, J. F. W. Jansen, J. E. J. Oberski, and A. H. Wapstra (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nuclear Phys., 35: 582-92(July 1962). (In English)

The decay of 6.5-hr Cd^{107} is studied with an iron-free double-focusing beta-spectrometer, scintillation spectrometers, and coincidence techniques. Twenty-one gamma transitions are found to occur between states in Ag^{107} with the following energies (kev), spins and parities: $0(1/2^-)$; $93(1/2^+)$; $126(7/2^+)$; $325(7/2^-)$; $423(5/2^-)$; $787(7/2^-?)$; $922(5/2^+)$; $949(7/2^-?)$; $1142(5/2^-)$; and $1222(5/2^+)$. The four positive parity states are interpreted as arising from various couplings of the $(g_{7/2})^{-3}$ proton configuration. Five of the negative parity states appear to be caused by coupling of a $p_{1/2}$ proton to the 0^+ ground state and the first and second 2^+ excited states of the even core. (auth)

26281 ON THE EXCITED STATES OF ^{10}B NEAR 7.5 Mev. R. J. Ellison and B. Dickinson (Manchester Univ., Eng.). Nuclear Phys., 35: 606-16(July 1962). (In English)

Internal electron pair angular correlations and γ-ray decay schemes in the reaction $Be^9(p,\gamma)B^{10}$ are investigated at proton bombarding energies from 850 to 1110 kev. The results show resonances at E_p = 935, 993, and 1084 kev, corresponding to levels in B^{10} at 7.42, 7.48, and 7.56 Mev respectively. Evidence that the 993-kev resonance may be a doublet is given. Comments are made on the probable spins and parities of these states. (auth)

26282 ELASTIC AND INELASTIC SCATTERING OF 30.8 Mev PROTONS FROM Ni^{60} AND Pb^{208}. D. W. Devins, H. H. Forster, and G. G. Gigas (Univ. of Southern California, Los Angeles). Nuclear Phys., 35: 617-24(July 1962). (In English)

The angular distributions of 30.8-Mev protons scattered elastically from Ni^{60} and Pb^{208} targets were obtained at angles ranging from $\approx$ 6 to 155° in the center-of-mass system. Data were fitted by an optical model calculation, which included both volume and surface absorption. Angular distributions of protons scattered inelastically from the 1.33-Mev (2+) level in Ni^{60} and from the 2.62-Mev (3−) level in Pb^{208} were measured and compared with the results of an inelastic diffraction scattering model. (auth)

26283 NUCLEAR LEVELS OF Ge^{74}. E. Eichler, G. D. O'Kelley, R. L. Robinson, J. A. Marinsky, and Noah R. Johnson (Oak Ridge National Lab., Tenn.). Nuclear Phys., 35: 625-44(July 1962). (In English)

By using gamma scintillation spectrometry and coincidence techniques, radiations from Ga^{74} and As^{74} are studied. A decay scheme consistent with most of the results is proposed with levels at 0.598, 1.20, 1.47, 1.71, 2.18, 2.53, 2.95, 3.05, 3.16, 3.33, 3.41, 3.57, and 3.88 Mev. A measurement of the angular correlation between the 0.598- and 0.60-Mev gamma rays confirms the predominantly E2 character of the 0.60-Mev (2+ → 2+) transition. (auth)

26284 THE EFFECTS OF SPIN-ORBIT DISTORTION IN DEUTERON STRIPPING REACTIONS. R. C. Johnson (Univ. of Manchester, Eng.). Nuclear Phys., 35: 654-75 (July 1962). (In English)

Proton differential cross sections and polarizations are calculated for the reactions $C^{12}(d,p)C^{13}$ (1st excited state) and $Si^{28}(d,p)Si^{29}$, at deuteron energies of 6 and 15 Mev respectively. The distorted-wave Born approximation is employed and spin-dependent proton distortion is taken into account. Spin-orbit distortion is found to leave a small effect on the cross sections, but the polarization is found to be large. In the case of the Si^{28} reactions agreement with the experimental polarization is obtained. An approximate treatment of both deuteron and proton spin-dependent distortion is developed and partially justified. Relatively simple expressions for the polarization effects are obtained. (auth)

26285 ISOBARIC SPIN DEPENDENCE OF THE OPTICAL POTENTIAL AND QUASI-ELASTIC (p,n) REACTIONS. A. M. Lane (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 35: 676-85(July 1962). (In English)

The isobaric spin dependence of the real part of the nuclear potential is investigated. Such a dependence is expected theoretically from the action of Heisenberg forces and the exchange effects of other forces. When suitably averaged, the isobaric spin term produces a dependence of the potential on the symmetry number (N−Z)/A. The isobaric spin dependence has two major implications: that all proton levels are split into two components; and that (p,n) reactions leading to the isobaric counterpart of the target state are predicted. (auth)

26286 LEVELS OF Os^{188}. L. B. Warner and R. K. Sheline (Florida State Univ., Tallahassee). Nuclear Phys., 36: 207-27(July 1962). (In English)

Ir^{188} was produced by $Re^{187}(\alpha,3n)Ir^{188}$ and studied in the Gerholm electron-electron coincidence spectrometer and a conventional gamma-gamma spectrometer, using fast-slow electronics. Re^{186} and Re^{186m} were produced by $Re^{187}(n,\gamma)Re^{188}$ and examined using fast-slow gamma-gamma coincidence equipment. The weak positon spectrum of Ir^{188} was analyzed and consisted of branches with end points at (1656 ± 10) and (1211 ± 45) kev, yielding Q_{β^+} = (1811 ± 10) kev. Coincidence relations and conversion electron energies, while confirming the main features of previously proposed decay schemes, suggest additional or adjusted states at 2225, 2106, 1846, 1732, and 1461 kev, all populated in the decay of Ir^{188}. Tentative levels were suggested at 788, 1941, and 2343 kev. The proposed scheme is compared with the models of Bohr and Mottelson and of Davydov et al.; these comparisons confirm the previous classification of Os^{188} as a transitional or intermediate-

coupling nucleus, in agreement with its location in the nuclear periodic table between strongly deformed and spherical nuclei. (auth)

26287 NUCLEAR BETA-DECAY ENERGY SYSTEMATICS INCLUDING EXCITED STATES. F. Everling (Ames Lab., Ames, Iowa). Nuclear Phys., 36: 228-46(July 1962). (IS-408) (In English)

A survey of experimental beta-decay energies involving ground states and excited states in the mass region A = 40 to 150 is presented. The data are compared with the hypothesis that straight lines are an approximation to the order of 30 kev in portions of the smooth, often bent Way and Wood trends and the corresponding constant neutron trends, which appear similar, as expected. An attempt was made to correlate states with the same spin and parity which seemed to belong to the same subshell. At the mass difference Cd-In, this permits the interpolation of $Cd^{111}-In^{111} = (-0.82 \pm 0.03)$ MeV, calculated from experimental data to be -1.24 ± 0.21. In Y^{93}, however, the hypothesis requires a $9/2^+$ ground state in contrast to the experimental $(1/2^-)$. Furthermore, the Pd^{99} (2.0 ± 0.1)-Mev β^+-ray must be assumed to lead to the Rh^{99} ground state. Two quadrangle-patterns can then be drawn in the range A = 91 to 101 for Y-Zr, Nb-Mo, Tc-Ru and Rh-Pd, being fivefold overdetermined. Each consists of 12 beta-decay energies interconnected by 7 straight lines. Twenty consequences concerning decay energies, excitation energies and spins are given as possibilities to check the hypothesis for this mass range. Its validity would mean that also the level distances, e.g., between the $1/2^-$ and $9/2^+$ states in Y, Nb, Tc and Rh for N = 50, 52, 54 and 56 each, vary almost linearly for isotopes and isotones, and that the subshell structure is not obscured by configuration mixing. (auth)

26288 THE SCATTERING OF NEUTRONS OF 15 Mev BY CARBON: SEPARATING THE NEUTRONS OF (α,n) DECAY OF C^{13}. Robert Barjon, Yves Flamant, Janine Perchereau, and Alain Rode (Université, Algiers). Nuclear Phys., 36: 247-57(July 1962). (In French)

The study by the time-of-flight method of 15-Mev neutrons scattered by carbon permits separation of the four first groups of neutrons elastically and inelastically scattered by C^{12} and the neutron group of the αn decay of excited states of C^{13}. (auth)

26289 THE DECAY SCHEME OF 39.3 h Es^{254}. J. Unik, P. Day, and S. Vandenbosch (Argonne National Lab., Ill.). Nuclear Phys., 36: 284-304(July 1962). (In English)

The beta decay of Es^{254} was studied using gamma-gamma and beta-gamma scintillation coincidence techniques and a double-lens beta-ray spectrometer. Transitions of 103.5 ± 1, 544 ± 5, 583 ± 3, 648 ± 2 and 692 ± 2 kev were placed in a level scheme of Fm^{254} with levels at 44 ± 3(2+, 0), 148 ± 3(4+, 0), 692 ± 2(2+, 2) and 734 ± 4(3+, 2) kev. Two beta spectra of 475 ± 5(75%) and 1127 ± 2(25%) kev were observed. The observation of the (2+, 2) gamma-vibrational state at 692 kev in Fm^{254} indicates a sharp decrease in the gamma vibrational energy after 152 neutrons. A half-life of 39.3 ± 0.2h was obtained for the Es^{254} beta emitter. Transitions of 93 ± 2, 377 ± 3, 387 ± 1 and 427 ± 3 kev were observed from the alpha decay of Es^{253}. (auth)

26290 MEASUREMENT OF THE POLARIZATION OF 7-8 Mev PROTONS INELASTICALLY SCATTERED FROM THE FIRST EXCITED STATES OF Ni^{58} AND Ti^{48}. E. E. Griffin and W. Parker Alford (Univ. of Rochester, N. Y.). Nuclear Phys., 36: 305-14(July 1962). (In English)

The polarization of 7 to 8-Mev protons inelastically scattered to the first excited states of Ni^{58} and Ti^{48} was measured at several angles. Large polarizations were observed. Compound-nucleus and direct-interaction processes contribute to the inelastic scattering, the former probably being most important. Since the conditions of the experiment were such that the statistical compound nucleus model is applicable, the appearance of polarization probably indicates a failure of the statistical assumption. This conclusion would be more certain if estimates of the polarization to be expected in direct interactions were available. If the observed polarization arises from compound nucleus processes, then the compound elastic scattering may be expected to be polarized also. Since compound elastic scattering is important for even nuclei at low energies, this effect might account for the difficulties found in fitting low energy polarization measurements with optical model calculations. (auth)

26291 THE $O^{17}(t,p)O^{19}$ REACTION IN A NUCLEAR REACTOR. R. Moreh and G. Davis (Israel Atomic Energy Commission, Rehovoth). Nuclear Phys., 36: 315-19(July 1962). (In English)

Using tritons from pile-irradiated Li^6, the reaction $O^{17}(t,p)O^{19}$ was observed. The thick target yield at $E_t \leq 2.73$ Mev was measured. The effective cross section of the reaction was 34 ± 7 mb. (auth)

26292 MEASUREMENT OF CIRCULAR POLARIZATION OF γ-QUANTA ACCOMPANYING La^{140} β-DECAY. I. V. Estulin and A. A. Petushkov (Moscow State Univ.). Nuclear Phys., 36: 334-41(July 1962). (In English)

The $(\beta\gamma)$ circular polarization correlation is measured in La^{140} by selection of photons at 1.6 Mev and β-spectrum electrons having an upper limit of 2.2 Mev in La^{140}. The resulting correlation coefficient is $\omega = +0.15 \pm 0.09$. Analysis of experimental data warrants the conclusion that the high value of log ft in the β-transition $3^- \rightarrow 2^+$ of La^{140} is due to the cancellation of nuclear matrix elements. The relative quantity of the relativistic matrix element is estimated. (auth)

26293 NUCLEAR STUDIES WITH Gd^{159}. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay). Nuclear Phys., 36: 342-51(July 1962). (In English)

The decay of Gd^{159} was investigated and accurate gamma intensities were determined. The 225-kev gamma → 79-kev gamma angular correlation was measured. The observed correlation supports the assignment of $5/2 \rightarrow 7/2 \rightarrow 5/2$ to the sequence of levels at 364, 136, and 57 kev. To deduce the effect due to the hindered β-transition, the shape of the β-spectrum in coincidence with 364-kev gamma rays was determined using a 4π-scintillation β-detector and the β-gamma (64-kev) angular correlation was measured to yield an anisotropy of $0.012 > A > -0.020$. Results are discussed. (auth)

26294 THERMAL NEUTRON CAPTURE CROSS SECTION AND RESONANCE CAPTURE INTEGRAL OF Ce^{144}. P. M. Lantz (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 13: 289-94(July 1962).

The thermal cross section, σ_{th}, and the resonance capture integral, I_θ, of Ce^{144} are measured by an activation method. The values are $\sigma_{th} = 1.00 \pm 0.10$ and $I_0 = 2.60 \pm 0.26$ barns, respectively. (auth)

26295 DECAY OF ^{105}Ag. R. Bhattacharyya (Saha Inst. of Nuclear Physics, Calcutta). Nuovo cimento, 24: 1000-5 (June 16, 1962). (In English)

Levels of Pd^{105} excited from the K-capture decay of Ag^{105} are investigated, using a NaI (Tl) sum γ spectrometer, and log ft values for these transitions are estimated. Results of γ-γ directional correlation measurements and a level scheme are also presented. (auth)

26296 INVESTIGATION OF A HIGH-ENERGY NUCLEAR INTERACTION. M. Kazuno (Dublin Inst. for Advanced Studies). Nuovo cimento, 24: 1013-33(June 16, 1962). (In English)

A nuclear interaction of $3 \cdot 10^{14}$ ev (the total energy of the secondary particles being $8.8 \cdot 10^{13}$ ev) is studied in an emulsion chamber. Sixty-five charged particles and 34 cores of electromagnetic cascades from π^0 mesons are observed. The angular distribution of the secondary particles is fairly isotropic. The value of $|\cos\theta^*|_{av}$ obtained is 0.66 ± 0.01 and the angular anisotropy obtained is about 2. Production ratios of the π^0 mesons to the charged particles and of the X^0 particles to the charged particles obtained are 0.33 ± 0.06 and 0.34 ± 0.12 respectively. The integral energy spectrum of the π^0 mesons in the laboratory system has an exponent -2.0. The Pt distribution of the π^0 mesons is continuous up to 2 Bev/c. Furthermore, a high value (about 2.9 Bev/c) of Pt of a single γ ray is found. The average value of Pt of π^0 mesons obtained is (0.49 ± 0.08) Bev/c. The Pt distribution is fitted well with Heisenberg's distribution. Inelasticity in the interaction estimated is 0.25. (auth)

26297 (n,α) REACTIONS IN HEAVY ELEMENTS. U. Facchini, M. G. Marcazzan, F. Merazri, and F. Tonolini (Laboratori CISE, Milan). Phys. Letters, 1: 6-8(Apr. 1, 1962). (In English)

The α spectra are measured at 15 to 23 Mev from (n,α) reactions on Ta^{181} and Au^{197} at a neutron energy of 14 Mev, utilizing Si detectors. Both the forward and backward spectra are determined. Integration over the spectra yields a cross section for Au (σAu) of 0.37 to 0.43 mb, and a σTa/σAu ratio of $\cong 2$. The low-energy (<15 Mev) α particles and deuterons from (n,α) and (n,d) reactions on Si^{28} and Si^{29} in the detector are also shown. (T.F.H.)

26298 BRANCHING RATIO OF ELECTROMAGNETIC TRANSITION TO THE FIRST EXCITED O^+ STATE IN O^{16}. G. Goldring (Weizmann Inst. of Science, Rehovoth, Israel) and B. Rosner. Phys. Letters, 1: 9-10(Apr. 1, 1962). (In English)

The branching ratio for the decay of the 7.12-Mev state of O^{16} via the 6.06-Mev state, as opposed to decay by a single 7.12-Mev transition, is examined. The measurements are carried out by looking for gamma rays at an energy of 7.12-Mev − 6.06 Mev = 1.06 Mev, in coincidence with internal electron-positron pairs produced in the 0^+ (6.06 Mev) → 0^+ (0 Mev) transition. An upper limit of 1/30 is obtained for the ratio of reduced transition probabilities to the excited state and ground state. (T.F.H.)

26299 ON THE POSSIBILITY OF RESONANT TRANSFER PROCESSES IN NUCLEAR REACTIONS. G. M. Temmer (Florida State Univ., Tallahassee). Phys. Letters, 1: 10-12(Apr. 1, 1962). (In English)

Small-angle elastic particle-transfer processes in nuclear reactions are discussed, using Li^6 bombarded by deuterons or α particles as an example. Li^6 may be thought of as being composed of He^4 + d, and the possibility of transfer of the d to the incident α, or of the He^4 to the incident d, is explored. The existence of the transfer is dependent on the collision time between the incident and target particles, and on the time required for the particle transfer to occur. The possibility of a back-and-forth shuttling of the resonantly transferred particle is also considered. (T.F.H.)

26300 A D.W.B.A. ANALYSIS OF STRIPPING USING MEASURED OPTICAL MODEL PARAMETERS. S. Hinds (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.), R. Middleton, and D. J. Pullen. Phys. Letters, 1: 12-14(Apr. 1, 1962). (In English)

The differential cross section is measured for the deuteron stripping reaction Se^{76}(d,p)Se^{77} at 7.8 Mev. Further, the differential elastic scattering cross sections are measured for 13-Mev protons on Se^{77} and 7.8-Mev deuterons on Se^{76}. From the scattering cross sections, optical model parameters are calculated for the proton and deuteron; these parameters are then used in the distorted-wave Born approximation (DWBA) to calculate the differential cross sections for the stripping reaction. Close agreement is obtained between the DWBA results and the experimental data. (T.F.H.)

26301 ELECTROMAGNETIC TRANSITIONS 6.92 Mev → 6.06 Mev AND 7.12 Mev → 6.06 Mev IN O^{16}. S. Gorodetzky, P. Mennrath, P. Chevallier, F. Scheibling, and G. Sutter (Institut de Recherches Nucléaires, Strasbourg). Phys. Letters, 1: 14-16(Apr. 1, 1962). (In French)

The branching ratio for the gamma decay of the 7.12-Mev level in O^{16} to the level at 6.06 Mev and to the ground state is calculated to be R(7.12 Mev → 6.06 Mev/7.12 Mev → 0 Mev) $\leq 3.5 \times 10^{-5}$. It is further found that R(6.92 Mev → 6.06 Mev/6.92 Mev → 0 Mev) = $(7.1 \pm 2.5) \times 10^{-5}$. The measurements are made by analyzing triple coincidences between the gamma ray of the ground-state transition and the internal electron-positron pairs from the $0^+ \rightarrow 0^+$ decay to the ground state of the 6.06-Mev level. (T.F.H.)

26302 MULTIPOLARITY OF THE 2.14 Mev TRANSITION IN B^{11}. S. Gorodetzky, F. Scheibling, P. Chevallier, P. Mennrath, and G. Sutter (Institut de Recherches Nucléaires, Strasbourg). Phys. Letters, 1: 24-5(Apr. 1, 1962). (In French)

The angular correlations of internal conversion electrons, from decay of the first excited state of B^{11} at 2.14 Mev, are measured at 37 to 120°. The multipolarity of the transition is found to be most probably M1, but it could be E2 or E3. Assuming the transition is M1, the results favor a spin-parity value for the 2.14-Mev level of $1/2^-$. (T.F.H.)

26303 PARTICLE-HOLE DESCRIPTION OF THE O^{16} SPECTRUM AND EFFECTIVE NUCLEAR FORCES. Vincent Gillet (Centre d'Études Nucléaires, Saclay, France) and Nicole Vinh Mau. Phys. Letters, 1: 25-8(Apr. 1, 1962). (In English)

A unified-model description of O^{16} nuclear excitations in terms of particle-hole interactions is investigated, using effective nuclear forces that depend on five adjustable parameters. The region of best fit to the experimental data is localized in the parameter 5-space; within this region the results are somewhat insensitive to parameter variations. The results of this analysis are used to predict excitation spectra for O^{16}. The levels predicted for odd-parity states with T = 0 or 1 are shown, and the agreement of the calculations and the experimental data is discussed. (T.F.H.)

26304 ISOTOPIC SPIN PURITY IN HEAVY NUCLEI AND ITS UNIMPORTANCE. A. M. Lane and J. M. Soper (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 1: 28-9(Apr. 1, 1962). (In English)

It is shown that the isotopic spin of heavy nuclei is a pure quantum number, at least for nuclei near the stability line. It is postulated that in the self-conjugate (N = Z) nucleus isotopic-spin mixing occurs, but that the addition of the excess neutrons required for stability dilutes the mixing. The significance of the isotopic spin of heavy nuclei is discussed. (T.F.H.)

26305 THE DESCRIPTION OF ROTATING NUCLEI. A. K. Kerman (Laboratoire Joliot-Curie de Physique Nu-

cléaire, Orsay, France) and Abraham Klein. Phys. Letters, 1: 185-7(June 15, 1962). (In English)

A generalization of the Hartree-Fock method used in studies of vibrational states of spherical nuclei and shapes of non-spherical nuclei is used to obtain dynamical properties of nuclear rotational states. (L.N.N.)

26306 NEUTRON-INDUCED REACTIONS IN SILICON. G. Dearnaley and A. T. G. Ferguson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 1: 196-8(June 15, 1962). (In English)

Silicon surface-barrier detectors were exposed to fast neutrons from a thin TiD target bombarded by deuterons from a 5-Mev Van de Graaff generator. Charged particles produced in the depletion layer caused pulses having amplitudes that varied linearly with energy. One group was ascribed to $Si^{29}(n,\alpha)$ reactions; the remainder, to (n,p) or (n,α) transitions to known levels in Al^{28}, Mg^{25}, or Mg^{28}. Intensities of all groups were proportional to the Si sensitive-layer volume; the effect was observed in diffused-junction Si detectors also. (L.N.N.)

26307 THE π^+-DECAY OF A HELIUM HYPERNUCLEUS. A. Z. M. Ismail, I. R. Kenyon, A. W. Key, S. Lokanathan, and Y. Prakash (Clarendon Lab., Oxford). Phys. Letters, 1: 199-202(June 15, 1962). (In English)

During the area scanning of a K5 emulsion track exposed to an 800-Mev/c K^- beam, a π^+ decay of a hypernucleus was detected. The event is illustrated, and data are presented in graphical and tabular forms. It is indicated that the hypernucleus is a $_{\Lambda}He^4$. (L.N.N.)

26308 EFFECT OF PAIRING CORRELATIONS ON THE ALPHA DECAY RATES. V. G. Soloviev (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Letters, 1: 202-5 (June 15, 1962). (In English)

Alpha decay theory is formulated within the framework of the superfluid model. Effects of superconductive pairing correlations on alpha decay absolute probabilities and on hindrance factors are investigated. Improved agreement between theory and data is obtained. (L.N.N.)

26309 STATISTICAL EMISSION AND ERICSON FLUCTUATIONS IN (p,α) AND (d,α) REACTIONS. U. Facchini, E. Saetta Menichella, and F. Tonolini (CISE, Milan). Phys. Letters, 1: 209-11(June 15, 1962). (In English)

Data on alpha and proton emission revealed anomalous behavior of cross sections and angular distributions. A group of these results is clarified using the statistical model and considering observations by T. Ericson (Advances in Physics, Phil. Mag. Suppl. 9: 425(1950)). Incident particles are at 20 to 50 kev, and compound-nuclei excitation energies are at about 18 Mev. Results are presented in graphical and tabular forms. (L.N.N.)

26310 THE $Mg^{26}(p,\alpha)Na^{23}$ REACTION. L. G. Lawrence and H. J. Hay (Australian National Univ., Canberra). Phys. Letters, 1: 212(June 15, 1962). (In English)

Spectra from the $Mg^{26}(p,\alpha)Na^{23}$ reaction at 9.90 Mev at 90 and 135° were measured using a 300 ohm-cm silicon surface barrier counter. The α groups were identified by reaction kinetics as those going to the known excited states of Na^{23} up to the ninth. Measured and calculated energies agreed within 20 kev. (L.N.N.)

26311 SPECTROSCOPY OF $0 \rightarrow\!\!\!\!\!\!\rightarrow 0$ TRANSITIONS. Zoltan Fried and Moon H. Cha (Naval Ordnance Lab., White Oak, Md.). Phys. Letters, 1: 220-2(June 15, 1962). (In English)

A method for measuring $0 \rightarrow\!\!\!\!\!\!\rightarrow 0$ transitions in a direct manner is presented. Samples are exposed to the simultaneous action of a high-flux microwave beam and a second radiation source having the requisite frequency corresponding to the level separation. For a 2-photon interaction, $0 \rightarrow\!\!\!\!\!\!\rightarrow 0$ transition is allowed. The method is applicable to atomic spectroscopy. The sample must be permeated by the microwave radiation; samples in metallic states are not amenable to this technique. (L.N.N.)

26312 AN EXAMPLE OF THE $_{\Lambda}Be^7$-HYPERNUCLEUS. S. J. St. Lorant and S. Lokanathan (Clarendon Lab., Oxford). Phys. Letters, 1: 223-5(June 15, 1962). (In English)

A coordinate reconstruction drawing of a $_{\Lambda}Be^7$ mesonic decay event detected in analyses of mesonic decays of hypernuclei emitted from K^- interactions at rest in an Ilford K5 emulsion stack is presented. Relevant measurements are summarized in tabular form. (L.N.N.)

26313 THE $Al^{27}(d,He^3)Mg^{26}$ REACTION. F. Pellegrini and S. Wiktor (Inst. of Nuclear Physics, Krakow). Phys. Letters, 1: 236-8(June 15, 1962). (In English)

The 12.8 Mev deuteron beam from a 120-cm cyclotron was used; the energy spread was about 120 kev. The He^3 particles were magnetically analyzed and registered in nuclear emulsions. To facilitate discrimination in scanning between He^3 and deuterons, underdeveloping was elaborated and applied by lowering the pH or the time of development. Scanning was coupled with straggling measurements. The discrimination error was below 10%. Angular distributions of He^3 particles are presented in graphical form; Mg^{26} energy levels are described. (L.N.N.)

26314 OPTICAL EMISSION FROM IRRADIATED FOILS. [PART] I. R. H. Ritchie and H. B. Eldridge (Oak Ridge National Lab., Tenn.). Phys. Rev., 126: 1935-47 (June 15, 1962).

Emission of optical radiation from foils irradiated with charged particles is studied. A generalization of the Ginsburg-Frank treatment is presented in which the wave properties of normally incident charged particles are accounted for in the Born approximation. The foil is assumed to be of finite thickness and to possess a dielectric constant of the form $\epsilon(\omega) = \epsilon_1(\omega) + i\epsilon_2(\omega)$. Predictions of the energy and angular distributions of emitted photons is made. The result reduces to that obtained by Ferrell if $\epsilon(\omega)$ appropriate to a free electron gas is assumed and if $v_1/c \ll 1$, where v_1 is the speed of the incident particle. Numerical results were obtained for foils of Ag and Al. (auth)

26315 OPTICAL EMISSION FROM IRRADIATED FOILS. [PART] II. A. L. Frank, E. T. Arakawa and R. D. Birkhoff (Oak Ridge National Lab., Tenn.). Phys. Rev., 126: 1947-52(June 15, 1962).

The spectra from silver foils irradiated by electron beams from an accelerator consist of weak maxima at 3500 Å and broad continua at longer wavelengths. The intensity of the maxima do not exhibit as strong a dependence on foil thickness as predicted by Ferrell and reported by Steinmann. The intensities of both maxima and the continua were found to be directly proportional to beam energy at 40 to 115 kev in agreement with the experiments of Goldsmith and Jelley, and of Boersch et al., and the theory of Ginsburg and Frank for transition radiation. The intensity of similar continua found for Al, Au, and Mg also increased linearly with beam energy. Light from Ag and Al foils was polarized in the plane containing the foil normal and the photon direction as predicted theoretically. The intensity of the light from silver was small near the foil normal and at angles approaching 90°, and achieved a maximum at an intermediate angle in agreement with the theories of Ferrell, and of Ritchie and Eldridge. The abso-

lute light yield from foils of Al and Ag revealed agreement with the predictions of Ritchie and Eldridge from the transition theory of Frank and Ginsburg. (auth)

26316 DEBYE-WALLER FACTOR FOR MÖSSBAUER RESONANT IMPURITY ATOMS. A. A. Maradudin and P. A. Flinn (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 126: 2059-71(June 15, 1962).

The probability for recoilless resonant gamma-ray emission or absorption by atoms present as impurities in a host lattice was evaluated in the high-temperature limit. The effect of interatomic force constant differences between impurity atoms and host lattice atoms is included explicitly for a simple model. The first-order quantum corrections were calculated for an isotopic impurity (no force constant difference). The Debye-Waller factor at high temperatures is determined largely by the stiffness of the host lattice, and partially by the forces between host and impurity atoms. The effects of the host and impurity masses appear only in the quantum corrections. (auth)

26317 ISOTOPE SHIFT IN THE SPECTRUM OF OSMIUM. Arthella P. Hines and John S. Ross (Rollins Coll., Winter Park, Fla.). Phys. Rev., 125: 2105-8(June 15, 1962).

Using enriched isotopes, the isotopic shift in five lines of the osmium spectrum, involving transitions of the type $5d^6 6s6p - 5d^6 6s^2$, was measured using Fabry-Perot interferometer. The average relative isotope shift for the even isotopic pairs, $\Delta\nu(192\text{-}190)$: $\Delta\nu(190\text{-}188)$: $\Delta\nu(188\text{-}186)$: $\Delta\nu(186\text{-}184)$, was 1.00 : 1.12 : 1.29 : 1.31, showing a leveling off in the isotope shift as the last neutron pair is subtracted. This results in a predicted intrinsic quadrupole miment for Os^{184} of 6.0×10^{-24} cm^2. The odd-isotope shift $\Delta\nu(192\text{-}190)$: $\Delta\nu(189\text{-}187)$ was 1.00 : 1.27. The average value for $\Delta\nu(190\text{-}188)$: $\Delta\nu(190\text{-}189)$ and $\Delta\nu(188\text{-}186)$: $\Delta\nu(188\text{-}187)$ was 1.00 : 0.69, illustrating the usual even-odd staggering effect. (auth)

26318 HYPERFINE STRUCTURE OF ATOMIC NITROGEN. W. W. Holloway, Jr., E. Luescher, and R. Novick (Univ. of Illinois, Urbana). Phys. Rev., 126: 2109-15 (June 15, 1962).

The hyperfine structure of the ground state of N^{14} and N^{15} was determined by optical pumping with spin exchange. A circulation system, which forced the nitrogen through an electrodeless rf discharge into the resonance bulb, provided a continuous source of atomic nitrogen. Optically-pumped cesium was used to polarize and analyze the nitrogen. The zero-field intervals extrapolated to zero pressure are N^{14}, $\nu(\frac{3}{2}-\frac{3}{2}) = 26{,}127{,}288 \pm 40$ cps; N^{14}, $\nu(\frac{1}{2}-\frac{1}{2}) = 15{,}676{,}390 \pm 40$ cps; and N^{15}, $\nu(2-1) = 29{,}290{,}902 \pm 40$ cps. The hyperfine constants are $A^{14} = (+)\ 10{,}450{,}925 \pm 20$ cps, $B^{14} = (-)\ 7 \pm 20$ cps, and $A^{15} = (-)14{,}645{,}441 \pm 20$ cps. These results include small corrections for second-order hyperfine interactions. A pressure shift of $+1.9 \pm 0.4$ cps/mm Hg of N_2 was established for the N^{14} magnetic dipole interaction constant (A^{14}). The hyperfine structure anomaly is $\Delta = (A^{14}g_I{}^{15}/A^{15}g_I{}^{14}) - 1 = +(1.002 \pm 0.004) \times 10^{-3}$. The effect of spin-orbit and spin-spin mixing of the ^4S, ^2D, and ^2P states is discussed. (auth)

26319 NEUTRON $d_{\frac{5}{2}}{}^n$ CONFIGURATIONS IN Zr ISOTOPES. Igal Talmi (Princeton Univ., N. J.). Phys. Rev., 126: 2116-19(June 15, 1962).

Energy levels of neutron $2d_{\frac{5}{2}}{}^n$ configurations are analyzed by shell-model methods. Experimental and calculated energies agree. The position of the $\frac{3}{2}^+$ level in Zr^{93} is predicted. Energies of these configurations to which a $2p_{\frac{1}{2}}$ is added (in Y isotopes) are considered by using a closed formula for the energies of $j^n j'$ configurations, with $j' = \frac{1}{2}$. (auth)

26320 VELOCITY AND ANGULAR DISTRIBUTIONS OF PROMPT NETURONS FROM SPONTANEOUS FISSION OF Cf^{252}. Harry R. Bowman, Stanley G. Thompson, J. C. D. Milton, and Wladyslaw J. Swiatecki (Univ. of California, Berkeley). Phys. Rev., 126: 2120-36(June 15, 1962). (UCRL-9713(Rev.))

Velocity and angular distributions of neutrons associated with light and heavy groups of fission fragments from spontaneous fission of Cf^{252} were measured. The results can be accounted for within about 10 to 20% by assuming isotropic evaporation from moving fragments. Least-squared fits to the data were made on this assumption and yield accurate values for the numbers of neutrons emitted by the light and heavy fragments and for their energy spectra. The energy spectra were analyzed in terms of effective temperatures of the fragments. A discussion of the systematic differences from simple evaporation theory is given. (auth)

26321 DIFFERENTIAL CROSS SECTIONS FOR THE REACTIONS $C^{12}(Li^6,\alpha)N^{14}$ AND $C^{12}(Li^7,\alpha)N^{15}$. Russell K. Hobbie and Fred F. Forbes (Univ. of Minnesota, Minneapolis). Phys. Rev., 126: 2137-41(June 15, 1962).

Differential cross sections were measured for the reactions $C^{12}(Li^6,\alpha)N^{14}$ and $C^{12}(Li^7,\alpha)N^{15}$ with the residual nuclei in their ground or first few excited states. The total cross section for the 2.31-Mev T = 1 state of N^{14} is 0.1 mb at 4.0 Mev, compared to a cross section of 2.9 mb for the ground state; this violation of the isotopic spin selection rule is probably due to mixing of different isotopic spin states in the compound nucleus F^{18}. The differential cross sections for the other levels have general features suggestive of a direct interaction. (auth)

26322 NUCLEAR MOMENT OF Ni^{61}. Lawrence H. Bennett and Ralph L. Streever, Jr. (National Bureau of Standards, Washington, D. C.). Phys. Rev., 126: 2141-2 (June 15, 1962).

The electron spin resonance spectra of nickel in MgO and nickel in germanium are studied. It is proposed that the estimated value of 0.3 nm for the nuclear moment of Ni^{61} is in error by a factor of three and that the value of 0.9 nm is more consistent with the published spectra. The internal fields in nickel and nickel alloys are discussed on this basis. (auth)

26323 PROTON-OXYGEN DIFFERENTIAL SCATTERING CROSS SECTIONS. [PART] II. S. R. Salisbury, G. Hardie, L. Oppliger, and R. Dangle (Univ. of Wisconsin, Madison). Phys. Rev., 126: 2143-7(June 15, 1962).

The differential cross section for the elastic scattering of protons on O^{16} was measured at 4.25 to 8.6 Mev. A differentially-pumped gas scattering chamber with a CsI(Tl) scintillation detector was used. Measurements were made at the following center-of-mass scattering angles: 30°2′, 54°25′, 90°0′, 103°48′, 122°57′, 140°25′, 148°50′, and 166°52′. Measurements were made at 0.0025- to 0.001-Mev intervals for target thicknesses of 0.0025 to 0.001 Mev at 166°52′. The other angles were measured at 0.001- to 0.040-Mev intervals for a 0.001- to 0.003-Mev target. The energy spread of the beam was probably less than 0.003 Mev. The uncertainties in the measured cross sections were approximately ±0.5%. Twenty-two resonances were found. (auth)

26324 F^{17} LEVEL PARAMETERS. S. R. Salisbury and H. T. Richards (Univ. of Wisconsin, Madison). Phys. Rev., 126: 2147-58(June 15, 1962)

$O^{16}(p,p)O^{16}$ differential cross section data at 2 to 7.6 Mev were used to assign parameters of F^{17} levels. The cross section data were first fitted to a partial-wave phase-shift expansion by a least-squares method using an IBM 704. The level parameters were then obtained by dispersion formalisms to the extracted phase shifts. The two-level approximation was used where appropriate. Four very narrow levels and the $\frac{7}{2}^-$ level at 3.47 Mev were ignored. Resonant energies and limits on widths for these and higher energy F^{17} states are given. Level schemes of O^{17} and F^{17} are compared. Assignment of levels to particular nuclear configurations is attempted. Illustrations of branching solutions in the phase-shift analysis are given. (auth)

26325 GAMMA RAYS RESULTING FROM LITHIUM BOMBARDMENTS OF LITHIUM. Edward H. Berkowitz (Iowa State Univ., Iowa City). Phys. Rev., 126: 2168-70 (June 15, 1962).

Beams of Li^6 and Li^7 were used to bombard thick targets of Li^6F and Li^7F. Reactions leading to Li^7, Be^7, Be^{10}, B^{10}, B^{11}, B^{12}, C^{11}, C^{12}, and C^{13} were identified from direct observation of gamma rays, residual target radiation, and the presence of neutrons. (auth)

26326 ISOBARIC STATES IN NONMIRROR NUCLEI. J. D. Anderson, C. Wong, and J. W. McClure (Univ. of California, Livermore). Phys. Rev., 126: 2170-3(June 15, 1962). (UCRL-6733)

The 14.8-Mev protons from the Livermore variable-energy cyclotron were used to study (p,n) spectra from 13 selected target nuclei with mass numbers from 48 to 93 for a laboratory angle of 23°. Neutron energies were determined using standard time-of-flight techniques. All spectra show one strong neutron group at an energy corresponding in excitation in the final nucleus to the isobaric counterpart (analog state) of the target ground state, i.e., the Q value is the usual Coulomb energy displacement. The strong forward peaking of the angular distribution of the neutrons corresponding to the analog state $V^{51}(p,n)Cr^{51}$ confirms the direct nature of the reaction. Although it is tempting, on the basis of the narrow width of the isobaric states (<300 kev), to imply some validity to isotopic spin as a quantum number for masses up to A = 93, isobaric states in adjoining nuclei can occur even in mass regions where isotopic spin is not a good quantum number. (auth)

26327 $S^{32}(p,p'\gamma)$ ANGULAR CORRELATIONS FROM 5.7 TO 6.34 Mev. H. Hulubei, N. Martalogu, J. Frantz, M. Ivascu, N. Scîntei, A. Berinde, and I. Neamu (Inst. for Atomic Physics, Bucharest). Phys. Rev., 126: 2174-7 (June 15, 1962).

Angular correlations were measured between protons scattered inelastically on S^{32} and the 2.25-Mev γ rays from the decay of the first excited state. Measurements were made at 5.7, 6.02, 6.2, and 6.34 Mev, the position of the proton detector being at 60, 90, 120, and 150°. The experimental correlations functions are all of the form $A + B \sin^2[2(\theta-\theta_0)]$, where θ_0 defines the axis of symmetry. At 6.02 Mev, θ_0 is only slightly different from the recoil angle θ_R; it is inferred that the reaction goes mainly through a direct interaction mechanism. At 6.34 Mev, θ_0 remains close to 90° for any scattering angle, in agreement with the compound nucleus theory. This suggests the presence of a strong resonance in the Cl^{33} compound nucleus. The correlations curves measured at 5.7 and 6.2 Mev are consistent with a competition between both reaction mechanisms. (auth)

26328 EXPERIMENTAL TEST OF THE CONSERVATION OF NUCLEONS. C. C. Giamati and F. Reines (Case Inst. of Tech., Cleveland). Phys. Rev., 126: 2178-88 (June 15, 1962).

The lower limit was measured for the lifetime of nucleons against spontaneous decay by processes which do not conserve the number of nucleons. The decay modes release charged particles with energies generally above 100 Mev. Possible decay events were sought using a 200-liter liquid scintillation detector. Backgrounds were due entirely to cosmic rays reduced by going 585 m underground and surrounding the scintillation detector by a water Cherenkov anticoincidence counter of over-all dimensions 2.4 m in diameter and 2.0 m high. The scintillation detector was set do detect pulses as low in energy as 8 Mev and hence was sensitive to a wider variety of decay events than previous experiments. Lifetime limits obtained range from 10^{25} to 7×10^{27} years depending on the decay mode assumed. (auth)

26329 INVESTIGATION OF LIGHT FRAGMENTATION PRODUCTS AND PECULIARITIES OF NUCLEAR FISSION AT HIGH ENERGIES OF INCIDENT PARTICLES. P. A. Goritchev, V. F. Darovskikh, O. V. Lozhkin, A. I. Obukhov, N. A. Perfilov, and U. P. Jakovlev (Radium Inst., Academy of Sciences, Leningrad). Phys. Rev., 126: 2196-2203 (June 15, 1962).

Nuclear emulsions were used to study the charge spectrum of fragments and the multiplicity of fragment production in disintegrations of Ag and Br nuclei caused by incident 9-Bev protons. Fission of Pb, Bi, and U by 660-Mev protons was investigated. (auth)

26330 HIGHER RANDOM PHASE APPROXIMATION AND ENERGY SPECTRA OF SPHERICAL NUCLEI. J. Sawicki (Universita, Bologna). Phys. Rev., 126: 2231-8(June 15, 1962).

An extension of the random phase approximation (RPA) is proposed to study the spectra of spherical nuclei. In contrast to the RPA method based on the linearized equations of motion of the one-nucleon excitation operators, in the higher random phase approximation (HRPA) the many-nucleon excitations are also included. Nuclear states are superpositions of the one- and many-nucleon excitations (i.e., particle-hole pairs). The modes consisting of one- and two-nucleon excitations were studied. In this second RPA, the secular problem obtained from the closed system of linearized equations of motion for the one particle-hole pair operators ("doubles") and the two-pair operators ("quadruples") are studied. States of definite nuclear spin, parity, and isotopic spin are considered. The method of the second RPA is illustrated in the example of the 6.06-Mev, $J^\pi = 0^+$, T = 0 state of O^{16}. Semiquantitative agreement with the experiment is obtained for this case. The second RPA is also discussed in connection with the "aligned coupling scheme." The importance of the method for the study of the vibrational 4^+ states is indicated. (auth)

26331 NUCLEAR ISOMER SHIFT IN THE OPTICAL SPECTRUM OF Hg^{185}. INTERPRETATION OF THE ODD-EVEN STAGGERING EFFECT IN ISOTOPE SHIFT. W. J. Tomlinson, III and H. H. Stroke (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 8: 436-8(June 1, 1962).

The isotope shifts in the Hg 2537Å emission line are found for neutron numbers from 114 to 124. The spins of Hg^{185} and Hg^{185m} are determined to be $\frac{1}{2}$ and $\frac{13}{2}$ respectively. Single neutrons in high angular momentum states are found to distort nuclei more strongly than do neutron pairs. An odd-even "staggering" effect is observed in the isotope shifts. The nucleus is found to be more polarizable

by the odd $p_{\frac{1}{2}}$ neutron as the neutron number varies from the magic number (126) toward the collective region. The variation of the mean-square nuclear charge radius is also found for neutron numbers from 114 to 124. (T.F.H.)

26332 NUCLEAR POLARIZATION OF He^3 GAS BY METASTABILITY EXCHANGE WITH OPTICALLY PUMPED METASTABLE He^3 ATOMS. G. K. Walters, F. D. Colegrove, and L. D. Schearer (Texas Instruments Inc., Dallas). Phys. Rev. Letters, 8: 439-42(June 1, 1962).

A small fraction of metastable He^3 is maintained, by means of a r-f discharge, in He^3 in a magnetic field. The metastable atoms are partially polarized by optical pumping using a 1-μ circularly polarized pumping light. Further, however, the stable and metastable atoms are capable of exchanging excitations; in the exchange reactions, the outgoing stable atoms may have magnetic quantum numbers differing by unity from those of the ingoing stable atoms. Thus spin-flip operators connecting the stable and metastable atoms are introduced, and the exchange reactions have the effect of polarizing the stable ground-state atoms. Nuclear polarizations of 0.8 and 3.5% are obtained at room temperature at pressures of 10 and 1 mm Hg respectively. Nuclear magnetic resonance studies of ground-state and $^3S_1$ He^3 atoms are also reported. (T.F.H.)

26333 EXCITED ISOBARIC STATES IN MEDIUM-A NUCLEI. J. D. Anderson and C. Wong (Univ. of California, Livermore). Phys. Rev. Letters, 8: 442-3(June 1, 1962). (UCRL-6830)

Experimental evidence is presented for the existence of excited isobaric states from the (p,n) reaction on medium-A, nonmirror, even nuclei (Ar^{40}, Ti^{48}, Fe^{56}, Ni, Zn, and Se). It is concluded that these states correspond to the excited isobaric states of the target nuclei. The proton energy is 17 Mev. Excited isobaric states are not observed in (p,n) reactions on odd-even nuclides V^{51} and Co^{59}. (T.F.H.)

26334 EFFECT OF NUCLEAR COLLECTIVE MOTIONS ON S- AND P-WAVE STRENGTH FUNCTIONS. B. Buck and F. Perey (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 8: 444-6(June 1, 1962).

The S- and P-wave strength functions are calculated for a large number of even-even nuclei with A from 34 to 242, using the optical model. The axially-symmetric-rotator model is used for permanently deformed nuclei, and the pure-quadrupole-vibration model for the dynamically deformable nuclei. The inclusion of the collective part of the optical-model potential yields better agreement with the experimental data than the spherical part of the optical potential alone. The model reproduces the experimentally observed structure in the S-wave strength function peaks near A = 55 and 160, and in the P-wave strength function peak near A = 100, but not in the S-wave strength function dip near A = 100. (T.F.H.)

26335 SOME PRECISION MASS DIFFERENCES BETWEEN TIN ISOTOPES. R. C. Barber, L. A. Cambey, J. H. Ormrod, R. L. Bishop, and H. E. Duckworth (McMaster Univ., Hamilton, Ont.). Phys. Rev. Letters, 9: 16(July 1, 1962).

Monovalent SnCl ions, obtained from electron bombardment of $SnCl_4$, provided doublets of the type $Sn^{A+2}Cl^{35}$ – $Sn^{A}Cl^{37}$. The doublet spacings were determined by a variation of the peak-matching technique, using a double-focusing mass spectrometer. Results, presented in tabular form, are accurate within 2 kev. (L.N.N.)

26336 MEASUREMENTS ON ELECTRON CAPTURE BRANCHING RATIOS IN THE DECAY OF THE NUCLIDES ^{54}Mn, ^{65}Zn, AND ^{57}Co. P. Kramer, E. C. Bos, A. De Beer, and J. Blok (Vrije Universiteit, Amsterdam). Physica 28: 569-81(June 1962).

The K capture fraction of a nuclide decaying by electron capture to an excited state can be determined by measuring coincidences between gamma quanta de-exciting this level and x radiation and/or Auger electrons following the K-capture process. By using a double proportional counter with an internal source x quanta and Auger electrons can be detected with nearly 100% efficiency. K capture fractions, P_K, are measured in the decay of Zn^{65} and Mn^{54}, resulting in values of P_K of 87.5 ± 0.6 and 90.2 ± 0.6% respectively. With summation measurements in the proportional counter the P_K of Co^{57} is determined as 87 ± 4%. (auth)

26337 *ON THE K/β^+ RATIO IN THE DECAY OF ^{58}Co.* P. Kramer, A. De Beer, and J. Blok (Vrije Universiteit, Amsterdam). Physica 28: 587-91(June 1962).

Using an internal source in a 4π proportional counter, the K/β^+ ratio in the decay of Co^{58} was determined to be 4.83 ± 0.1. (auth)

26338 SPIN ALIGNMENT OF DEUTERONS ELASTICALLY SCATTERED FROM CARBON. A. G. Gregory, G. D. Symons, and P. B. Treacy (Australian National Univ., Canberra). Proc. Phys. Soc. (London), 80: 315-17(July 1, 1962).

A double scattering experiment is performed in which 0.96-Mev deuterons are elastically scattered by the 0.96-Mev 1^+ resonance in C^{12} through an angle of 30°, and the scattered deuterons (at energy E_s) then undergo the reaction $C^{12}(d,p)C^{13}$ with a d-p angle of 90°. The yield $Y(\phi)$ of this double reaction is measured as a function of the angle (ϕ) between the (d,d) and (d,p) reaction planes, and of E_s between 0.8 and 1.10 Mev. The value $[Y(0°) + (180°)] - [Y(90°) + Y(270°)]$ is measured as a function of E_s, and this value is used as a criterion of the asymmetry. The asymmetry is also calculated assuming that the (d,p) reaction is a compound-nucleus reaction proceeding through competing s- and d-wave channels. The data are found to be consistent with a reduced d-wave/s-wave amplitude ratio of 4.8. (T.F.H.)

26339 AN ANALYSIS OF THE $F^{19}(d,p)F^{20}$ REACTION. Tsunekichi Dazai (Tokyo Inst. of Tech.). Progr. Theoret. Phys. (Kyoto), 27: 433-43(Mar. 1962). (In English)

A shell model calculation of stripping reduced widths of even parity and an analysis of a resonance found in the excitation function in the $F^{19}(d,p)F^{20}$ reaction were made under simplifying assumptions. A reasonable fit with experiment was obtained for $l_n = 2$, which is observed for low-lying levels in F^{20}, agreement with experiment is satisfactory in relative and in absolute values of the stripping reduced width. The modified multiplet model seems to be valid. For $l_n = 0$, corresponding to higher excited levels in F^{20}, the relative values were not well-reproduced, and a high degree of configuration mixing seems to be effective, since the sum rule gives a reasonable value of $\theta^2_S(2s)$. The reaction data are consistent with the assignment of 2^+ to the ground state of F^{20}, derived from beta-decay evidences, and with the statement by C. Schwartz (Phys. Rev., 94: 95(1954)) with respect to a doublet of levels resulting from coupling of an $s_{\frac{1}{2}}$-proton and the three-neutron-configuration, $(d^3_{\frac{5}{2}})_{\frac{1}{2}}$. Spin values are temporarily assigned to a few levels in F^{20}. (auth)

26340 MESON-THEORETICAL INTERACTIONS IN HEAVY NUCLEI. Kenji Hasegawa (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 27: 449-60(Mar. 1962). (In English)

Effective nuclear interactions in heavy nuclei are dis-

cussed on the basis of a semiphenomenological Hamiltonian for pion-nucleon interactions. Upon applying a canonical transformation, the Hamiltonian is diagonalized approximately. The resultant Hamiltonian consists of the single-particle energy of nucleons, the energy of the effective meson field, and the effective interaction between nucleons. The characteristic meson pair term shortens the range of the two-body correlations and produces a positive average potential, which may be another cause for the nuclear saturation and may favor the independent-particle behavior. (auth)

26341 SYNTHESIS OF ELEMENTS IN THE RANGE A = 60 ~ 74 BY THE RAPID NUCLEAR PROCESS. Hiroyuki Tsuji (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 27: 608-9(Mar. 1962). (In English)

Rates of (p,γ) and (γ,p) reactions are calculated at (0.5 to 2.0) × 10^9 °K at 10^{-1} to 10^2 gm cm^{-3} density (C. Hayashi et al., Progr. Theoret. Phys., 22: 101(1959)). Relative abundances of A = 60 to 74 elements can be explained at (1.0 to 1.2) × 10^9 °K at 1 gm cm^{-3} and at (1.2 to 1.5) × 10^9 °K at 10 gm cm^{-3}. Capture of several protons per Fe^{56} is required for steady flow establishment; the average atomic weight is at 62 to 63. The p process may be effective for element synthesis at A = 60 to 74, although the coincidence of calculated to observed abundances is affected by the Q-value uncertainty for the proton-rich nuclei. (L.N.N.)

26342 ABSORPTIVE EFFECTS IN ELASTIC DEUTERON SCATTERING. William S. Porter (Bucknell Univ., Lewisburg, Penna.). Progr. Theoret. Phys. (Kyoto), 27: 615-16(Mar. 1962). (In English)

Deuteron scattering data for Ti^{48}, Cr^{52}, and Ni^{59} were analyzed by a method emphasizing the importance of absorptive effects (H. S. W. Massey, Handbuch der Physik XXXVI (Springer, 1956), 275). The nuclear phase shift was taken to be zero, and it is implied that departures from pure Coulomb scattering are due to absorption. However, the nature of the absorptive mechanism is not clear and may arise from electric break-up or from a specifically nuclear reaction. (L.N.N.)

26343 THE EXCITED O^+ STATE AND CENTER-OF-MASS EFFECTS IN OXYGEN-16. Hiroyuki Nagai (Kyushu Inst. of Tech., Tobata, Japan). Progr. Theoret. Phys. (Kyoto), 27: 619-37(Apr. 1962). (In English)

The first excited state of O^{16} is investigated using the harmonic-oscillator shell model with a nuclear interaction. A central potential with a Yukawa shape and Rosenfeld mixture is assumed as the residual interaction. The first excited state is assumed to be an admixture of possible configurations having an excitation energy of $2\hbar\omega$ above the shell model ground state that has a wave function corresponding to the double closed configuration $(1s)^4\ (1p)^{12}$. The excitation energy is 6.06 Mev, and the monopole transition probability to the ground state is known. The calculated matrix element (4.7×10^{-26} cm^3) agrees with the observed value (3.8×10^{-26} cm^2), while the calculated excitation energy is twice as large as the experimental excitation energy. After considering effects of the center-of-mass motion and removing the spurious states, the excitation energy is increased by 15%, and the monopole matrix element increases to twice the experimental value. The lowest excited 0^+ state obtained by the usual shell model calculation corresponds to the spurious state with the 2s center-of-mass motion. (auth)

26344 BINDING ENERGY OF HYPERNUCLEI. [PART] I. S. K. Shah and S. P. Pandya (Physical Research Lab., Ahmedabad, India). Progr. Theoret. Phys. (Kyoto), 27: 837-8(Apr. 1962). (In English)

Data on binding energies of Λ hypernuclei at A = 3 to 13 are summarized. The binding energies are dependent on the structures, and spin dependence of the Λ-nucleon interaction is indicated. (L.N.N.)

26345 A SCHEMATIC THEORY OF NUCLEAR REACTIONS. F. Medina Nicolau (Universidad Nacional, Mexico). Rev. mex. fix., 11: 55-71(1962). (In English)

A description of a many-channel nuclear reaction is given on the basis of the formalism of boundary conditions by Moshinsky. The interaction between the particles takes place at the point of contact? As a result of the interaction, a compound particle, which is analogous to the compound nucleus in a nuclear reaction, can be formed. The behavior of the wave function describing the relative motion of the particles in the different channels is determined by a set of conditions that must be satisfied at the point of contact. In this formalism, there is the possibility of a direct interaction, i.e., reactions which proceed without the formation of a compound particle. The general form of the S-Matrix, which includes the compound nucleus and the direct interaction contributions, is derived. An interpretation of the modulation of the reduced widths of the resonances associated with the compound particles is given; the modulation was explained by the optical nuclear model. The behavior of the transfer cross section when the reaction takes place through the direct interaction mechanism is explained. (auth)

26346 MEASUREMENT OF THE ANGULAR CORRELATIONS OF GAMMA-GAMMA CASCADES OF DY^{160}. L. Simons, E. Spring, G. Wendt, and L. Kaeld (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 26: No. 10, 1-26(1962). (In English)

Gamma rays in Dy^{160} were studied by coincidence and angular correlation methods. Dy^{160} is obtained following beta decay of Tb^{160}, which has a half-life of 72 days. Measurements were made of the angular correlations of the 299 to 966, 392 to 879, 392 to 966, 1272 to 87, 1115 to 197, and 1312 to 87-kev gamma cascades. Results assign spin 2^- for the 1264, spin 2^- for the 1358, and spin 3^- for the 1399-kev level. Multipole orders for the gamma rays included in the cascades confirm results of internal-conversion measurements. Coincidence spectra show that the 1115-kev transition occurs between the 1399 and 284-kev levels. For the 1264-kev level, K = 2; for the 1358-kev level, K = 1 (or 2); and for the 1399-kev level, K = 0 (or 1). The energies of the positive parity levels and the intensities of the associated gamma rays are in better agreement with the asymmetric rotor-theory than with the unified model-theory. (auth)

26347 PROTON POLARIZATION IN STRIPPING REACTION OF B^{10}. D. I. Tambovtsev. Ukrain. Fiz. Zhur., 7: 244-55(1962). (In Russian)

The angular distribution of proton polarization from $B^{10}(d,p)B^{11}$ is given for the ground state group of B^{11}. The 13.8-Mev deuteron beam current is 12 μa. The polarization is measured for protons emerging from the target within an angular range of 10 to 70°. The sign of polarization and the qualitative character of the angular distribution agree with a particular theory. A description is given of the experimental apparatus and procedure. (auth)

26348 CALCULATIONS OF HIGH-DENSITY MOMENTS OF NUCLEAR CHARGE IN BREMSSTRAHLUNG EMISSION OF LONGITUDINALLY POLARIZED ELECTRONS. F. S. Sadykhov. Vestnik Moskov. Univ., Ser. III, No. 1, 19-32 (Jan.-Feb.). (In Russian)

The influence of the fourth moment of nuclear charge density on bremsstrahlung emission by longitudinally

polarized relativistic electrons was analyzed. The cross section relationship and bremsstrahlung circular polarization are developed as functions of the emission angle θ, γ quanta at $E_e = 250$ Mev, $\epsilon_\gamma = 125$ Mev, and $S = 1$ for C^{12} nuclei. It was found that at high energies and large angles, high-density nuclear charge moments exert considerable influence on angular distribution, cross section, and bremsstrahlung polarization. (R.V.J.)

26349 CROSS SECTIONS OF 6.6 Mev PROTON ABSORPTION BY Cu^{63} AND Cu^{65} NUCLEI. S. S. Vasilev, E. A. Romanovskii, G. F. Timushev. Vestnik Moskov. Univ., Ser. III, No. 1, 94-5(Jan.-Feb. 1962). (In Russian)

Differential cross sections of inelastic proton scattering by Cu^{63} and Cu^{65} in mb/sterad at $E_p = 6.6$ Mev are tabulated. The order of error is 5 to 7% for peaks that do not overlap and ≈ 15% for overlapping peaks. The angular distributions for six Cu^{63} levels and 2 Cu^{65} levels are isotropic, indicating that inelastic scattering passes through a compound nucleus. The absolute partial excitations found for 46 levels in Cu^{63} and 21 levels in Cu^{65} were 240 ± 30 mb and 70 ± 15 mb, respectively. The cross sections of proton elastic scattering through a compound nucleus in Cu^{63} and Cu^{65} are evaluated by inelastic scattering with primary level excitation taken as ≈ 20 to 25 mb for Cu^{63} and ≈ 10 to 15 mb for Cu^{65}. The results are: for reactions Cu^{63} $\sigma_\gamma = 600$ mb and for Cu^{65} $\sigma_\gamma = 617$ mb. Correlations of measured cross-sections with optical-model calculations should determine the extent of proton absorption in depth. (R.V.J.)

26350 THE DEUTERIUM TEAR ON THE NON-COAXIAL NUCLEI. W. K. Lukjanov. Vestnik Moskov. Univ., Ser. III, No. 2, 74-9(Mar.-Apr. 1962). (In Russian)

Variations in angular distribution, polarization, and reduced widths in induced deuterium stripping on non-axial nuclei are analyzed. (tr-auth)

26351 MEASUREMENTS OF THE K CONVERSION COEFFICIENTS AND THE ACTIVATION CROSS SECTION OF THE ISOMERIC NUCLEI Se^{77m}, Se^{79m}, Ge^{75m}, AND Ge^{77m}. Hermann Weigmann (Universität, Göttingen, Ger.). Z. Physik, 167: 549-57(1962). (In German)

The K conversion coefficients α_K of the nuclear isomers Se^{77m}, Se^{79m}, Ge^{75m}, and Ge^{77m} were measured by detecting the K x-ray and γ radiation from neutron-irradiated Se and GeO_2 samples with the aid of scintillation counters to be $\alpha_K = 0.79 \pm 0.06$, 7.4 ± 0.6, 1.44 ± 0.13, and 1.2 ± 0.6, respectively. In all cases, the values obtained, are in agreement with those taken from the tables of Rose under the assumption of an E3 transition, thus confirming this assignment which was proposed earlier by other authors. In addition, the cross sections σ for inducing the activities by slowed down neutrons were measured to be $\sigma = 22 \pm 2$, 0.40 ± 0.04, 0.20 ± 0.02, and 0.12 ± 0.03 barns, respectively, and are compared with earlier data of several authors. (auth)

26352 SCATTERING OF LOW ENERGY PROTONS ON S^{32}. H. Hulubei, I. Neamu, I. Franz, N. Martalogu, N. Scintei, M. Ivascu, and A. Berinde (Inst. of Nuclear Physics, Academy of Sciences, Rumanian Peoples Republic). Zhur. Eksptl'. i Teoret. Fiz., 42: 1433-7(June 1962). (In Russian)

The angular distributions of protons elastically and inelastically scattered on S^{32} are measured at 5.7, 5.85, 6.02, 6.20, and 6.34 Mev. The inelastic scattering (Q = −2.24 Mev) distribution curves obtained are very sensitive to the incident proton energy; this indicates that compound nucleus formation is involved. The elastic scattering angular distribution curves indicate that near 6.02 to 6.34 Mev, the compound nucleus mechanism is increasingly important. (auth)

26353 INVESTIGATION OF THE $Li^7(\gamma,p)He^6$ REACTION. A. Kh. Shardanov and V. G. Shevchenko (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 1438-41 (June 1962). (In Russian)

Cross sections and energy and angular distributions of photoprotons from the $Li^7(\gamma,p)He^6$ reaction are measured. Peaks at 2.3, 3.2, and 3.9 Mev are observed in the energy spectrum. Excited Li^7 nuclear states at 12.5, 13.5, and 14.3 Mev, respectively, correspond to the three peaks. The cross sections for the indicated proton groups are obtained. (auth)

26354 INVESTIGATION OF THE $Al^{27}(p,p\pi^+)Mg^{27}$ REACTION. M. Ya. Kuznetsova, V. N. Pokrovskii, and V. N. Rybakov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1451-5(June 1962). (In Russian)

The excitation function of the $Al^{27}(p,p\pi^+)Mg^{27}$ reaction is obtained at 130 and 660 Mev. The reaction threshold is near 200 Mev. The excitation function levels at 500 to 550 Mev are studied. On the plateau, the $Al^{27}(p,p\pi^+)Mg^{27}$ reaction cross section is 0.16 ± 0.02 mb. (auth)

26355 KINETIC ENERGY OF THE FRAGMENTS EMITTED IN THE FISSION OF U^{238} BOMBARDED BY 14.5 Mev NEUTRONS. V. M. Adamov, S. S. Kovalenko, and K. A. Petrzhak. Zhur. Eksptl'. i Teoret. Fiz., 42: 1475-7 (June 1962). (In Russian)

The total kinetic energy of U^{238} fission fragments produced by 14.5-Mev neutron bombardment is measured using a double ionization chamber for mass ratios at 1.0, 1.1, 1.2, 1.3, 1.43, and 1.56. Altogether, 3×10^5 fission events were recorded. The difference between the maximal kinetic energy and its value for symmetric fission is 15 ± 2 Mev. A comparison with the similar difference for thermal neutron induced fission in neighboring nuclei indicates that with increase of the bombarding particle energy, the kinetic energy of symmetric fragments increases. (auth)

26356 "GROSS STRUCTURE" OF PROTON SPECTRA IN STRIPPING REACTIONS. O. F. Nemets and V. V. Tokarevskii. Zhur. Eksptl'. i Teoret. Fiz., 42: 1481-7 (June 1962). (In Russian)

The proton energy spectra in (d,p) reactions are measured for 21 nuclei. Angular distributions of proton groups are measured in the region where separate levels cannot be resolved. An analysis of the spectra and angular distributions shows that the gross structure peaks can be identified using groups of single-particle excited states forming the nuclear neutron shell. (auth)

26357 SPLITTING OF THE GIANT RESONANCE IN MEDIUM-HEAVY NUCLEI. O. V. Bogdankevich, B. I. Goryachev, and V. A. Zapevalov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 1502-14(June 1962). (In Russian)

Neutron yields from Rh^{103}, Ag^{107}, In^{115}, Tb^{159}, and Ta^{181} nuclei are measured with the FIAN-30 synchrotron from the (γ,n) reaction threshold to 23 Mev. The γ absorption cross sections for the indicated nuclei are computed on the basis of the measured yields. For the Rh^{103}, In^{115}, Tb^{159}, and Ta^{181} nuclei a splitting of the giant resonance was detected which is due to deviation of the nuclear shape from a spherically symmetric one. There are indications of a non-axiality of the terbium nucleus. (auth)

26358 EQUILIBRIUM SHAPES OF NUCLEI IN THE QUASISTATIC FISSION MODEL. V. M. Strutinskii. Zhur. Eksptl'. i Teoret. Fiz., 42: 1571-81(June 1962). (In Russian)

An iteration method is proposed for solving the variational problem of determining nuclear equilibrium shapes

and fission barriers. The method is based on the weak dependence of the equilibrium shapes on the Coulomb potential for fixed nuclear deformation and volume. Properties of solutions of the zero approximation which formally corresponds to x = 0 are considered. (auth)

26359 "ANHARMONIC" EFFECTS OF QUADRUPOLE OSCILLATIONS OF SPHERICAL NUCLEI. S. T. Belyaev and V. G. Zelvinskii. Zhur. Eksptl'. i Teoret. Fiz., 42: 1590-1603(June 1962). (In Russian)

Deviations from the fundamental harmonic approximation are considered in the microscopic theory of collective excitations of spherical even-even nuclei. In a first approximation in the adiabaticity parameter, the anharmonic corrections can be expressed in terms of a single-parameter. Corrections to the wave functions, shifts of energy levels, and the probabilities for E2-transitions for the first two excited states are determined. Second approximation corrections expressed through a single parameter are considered. (auth)

26360 CORRECTION TO FINITE NUCLEAR SIZE IN THE ISOTOPIC SHIFT. F. A. Babushkin (Komi State Pedagogical Inst., USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1604-7(June 1962). (In Russian)

An expression for the isotopic shift of energy levels is deduced. Shifts of the x-ray levels $1s_{1/2}$, $2s_{1/2}$, $2p_{1/2}$ are calculated for Mo, Pb, and U. The correction to the isotopic shift of the optical $ns_{1/2}$-terms is determined for Hg. (auth)

26361 CALCULATION OF THE FISSION THRESHOLD AND FRAGMENT EXCITATION ENERGIES IN THE DROP MODEL OF THE NUCLEUS BY TAKING INTO ACCOUNT THE WIGNER SYMMETRY ENERGY. V. S. Stavinskii and V. P. Kovalev. Zhur. Eksptl'. i Teoret. Fiz., 42: 1614-17 (June 1962). (In Russian)

It is shown that the correlation observed experimentally between the spontaneous fission characteristics and the surplus of neutrons relative to protons in a fissioning nucleus can be obtained by taking into account the dependence of the Wigner symmetry energy on nuclear deformation. Quantitative agreement between the theory and experiment can also be improved by considering this dependence. (auth)

26362 PHOTOPRODUCTION OF CHARGED VECTOR MESON PAIRS IN THE COULOMB FIELD OF NUCLEI. I. V. Lyagin and I. S. Tsukerman (Inst. of Scientific Information, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1618-21(June 1962). (In Russian)

The Weizsacker–Williams method is used to calculate the total cross section for photoproduction of vector boson (B-meson) pairs in the Coulomb field of a nucleus by considering the anomalous magnetic moment of the bosons. (auth)

26363 DECAY OF HYPERNUCLEI. V. A. Lulka. Zhur. Eksptl'. i Teoret. Fiz., 42: 1629-31(June 1962). (In Russian)

The energy and angular distributions of π mesons and protons from the $\Lambda He^5 \rightarrow He^4 + p + \pi^-$ decay are calculated in the impulse approximation. The calculated distributions are compared with data. (auth)

26364 ON γ-RADIATION FROM A COMPOUND NUCLEUS WITH A LARGE ANGULAR MOMENTUM. V. V. Babikov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1647-50(June 1962). (In Russian)

The main characteristics of the γ radiation from a compound nucleus having a high angular momentum are derived under the assumption that complete statistical equilibrium is attained. (auth)

26365 ELASTIC π^- MESON SCATTERING ON CARBON AT 5 TO 15 Mev. V. S. Demidov, V. G. Kirillov-Uzryumov, A. K. Ponosov, V. P. Protasov, and F. M. Sergeev (Moscow Inst. of Engineering Physics). Zhur. Eksptl'. i Teoret. Fiz., 42: 1687-8(June 1962). (In Russian)

Previous studies of elastic π^- scattering on C at less than 22 Mev indicated the presence of an effective repulsion potential. An analysis of π^- scattering at identical energies was made in order to determine the π-nucleus potential by the difference in the interference of electromagnetic and nuclear interactions. A 370 × 140 × 100 mm propane bubble chamber irradiated by a 5 to 15 Mev π^- beam was used in the experiment. The tabulated results, compared with the data for π^+, revealed a region (20 to 120° angle) where the π^- scattering is much weaker than the π^+. Further studies showed that in the weaker region the contributons of interfering Coulomb and nuclear interactions are highly pronounced. The divergence in the angular distributions of π^- and π^+ permit a direct determination of the π-carbon nucleus potential that corresponds to β-state repulsion. The obtained data were used for evaluating the phase shifts in π^- scattering on C and, in turn, the β-state repulsion. The data are in close agreement with those of N. Byers (Phys. Rev 107: 843(1957)). (R.V.J.)

26366 LANDOLT-BORNSTEIN NUMERICAL DATA AND FUNCTIONAL RELATIONSHIPS IN SCIENCE AND TECHNOLOGY. NEW SERIES. K. H. Hellwege, ed.-in-chief. Group I: Nuclear Physics and Technology. Volume I. Energy Levels of Nuclei: A = 5 to A = 257. Berlin, Springer, Verlag, 1961. 825p.

The known energy levels and transitions for all nuclei from A = 5 to 257 are given. (M.C.G.)

Particle Accelerators

26367 (AFOSR-1631) ANALYSIS OF ENERGY EFFICIENCY OF RAIL ACCELERATORS. Engineering Department Report 2252. George M. Palmer (Midwest Applied Science Corp., Lafayette, Ind. and Allison Div., General Motors Corp., Indianapolis.). July 1961. Contract AF 49(638)-864. 28p. (AD-267221)

Application of possible energy loss mechanisms to the rail accelerator problem has shown how large amounts of energy could be consumed and not become available as axial kinetic energy. Axial kinetic energy vs specific impulse plots indicate that a specific impulse of 10,000 sec would require a kinetic energy of 40 Joules. For the conditions considered, radial kinetic energy and the plasma formation and heat energy are negligible by comparison. Thus, an efficiency of 10 to 20% based on absorbed energy is implied depending upon emissivity up to a 50% reduction. The range of efficiency is in good agreement with experimental results. Two of the mechanisms considered, Joullian heating of the rails and radio frequency electromagnetic radiation, were found completely negligible. Although the relative energy contained in radial motion at the velocities considered is small compared with the thermal radiation energy losses, a reduction in radial velocity has a corresponding effect on the radiation by reducing the radiating surface area for a given time interval. A marked improvement in efficiency could be realized by utilizing a cold plasma so that losses based on temperature could be reduced. (auth)

26368 (AFOSR-2580) THEORETICAL AND EXPERIMENTAL STUDY OF HIGH ENERGY BUNCHED ELECTRON BEAMS AND STUDIES IN QUANTUM AND SOLID STATE ELECTRONICS. Final Report, March 1, 1956–

February 28, 1962. Paul D. Coleman (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Feb. 28, 1962. Contract AF 18(603)-62. 45p.

A summary of the work reported in 12 technical status and 10 technical operating reports issued on this contract is presented. Fifteen problems were studied during the course of this work of which three were active as of 28 February 1962. The general aims and accomplishments of the contract are discussed, and a survey of problems, the specific objective, and results on each are given. Problem areas included study of high energy bunched electron beams, study of frequency conversion in the low millimeter region by field emission, gas discharges, and ferrites, study of tensor media resonators using ferrites, study of coupling electron beams to Fabry-Perot resonators, study of optical pumping, study of optical frequency mixing, and study of submillimeter masers. A list of reports, conference talks, and papers along with the personnel associated with the work are included. (auth)

26369 (CEA-2109) LES SEPARATEURS DE PARTICULES DU TYPE H F. (The H F Type Particle Separators). P. Lapostolle (France. Institut National des Sciences et Techniques Nucléaires, Paris). 1961. 24p.

A general theory is developed for H.F. type separators designed essentially for the analysis of very high energy beams. Analytical expressions are given for the deviation and the separation which are then presented in the phase space and in the matrix form. The diagrams proposed by Panofsky, Good, and Blewett are described. A few recommendations are made concerning the choice of the device and of the parameters. (auth)

26370 (DESY-A1.9) DIE POLFLÄCHENWINDUNGEN FÜR DEN DESY-MAGNETEN. (The Pole Surface Face Windings for the DESY Magnets). W. Hardt (Deutsches Elektronen-Synchrotron, Hamburg). Apr. 9, 1962. 18p.

Reasons for needing the pole face windings are outlined. The way in which the correct additional field is obtained is discussed. The arrangement and construction of the pole face windings for the magnets in the German Electron-Synchrotron (DESY) are described. (M.C.G.)

26371 (JINR-P-930) VOPROSY TEORII I MODELIROVANIYA KOL'TSEVOGO FAZOTRONA SO SPIRAL'NOI STRUKTUROI MAGNITNOGO POLYA. (Problems in the Theory and Modeling of Annular Phasatron with Spiral Magnetic Field Structure). D. P. Vasilevskaya, A. A. Glazov, Yu. N. Denisov, V. P. Dzhelepov, V. P. Dmitrievskii, B. I. Zamolodchikov, N. L. Zaplatin, V. V. Kol'ga, A. A. Kropin, M. Kuzmyak, L. N. Onishchenko, V. S. Rybalko, L. A. Sarkisyan, and E. Shvabe (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 7p.

The problems in modeling an annular proton phasotron for studying particle injection into the spiral magnetic field and finding the optimum conditions for particle capture are analyzed. (R.V.J.)

26372 (JINR-P-931) KOMPENSATSIYA NELINEINYKH REZONANSOV V RELYATIVISTSKOM TSIKLOTRONE. (Compensation of Nonlinear Resonances in Relativistic Cyclotron). V. V. Kol'ga (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 5p.

The compensation of intrinsic nonlinear resonances in a relativistic cyclotron was studied, and it was found that compensation can be realized in the resonance zone by introducing artificial harmonics with amplitudes depending on the radius. (R.V.J.)

26373 (NP-11693) EL DEFLECTOR MAGNÉTICO DEL HAZ DEL SINCROCICLOTRÓN DE BUENOS AIRES. INFORME NO. 45. (Magnetic Deflector System of Buenos Aires Synchrocyclotron Beam. Report No. 45). J. Rosenblatt and R. J. Slobodrian (Argentina. Comisión Nacionalde Energía Atómica, Buenos Aires). 1960. 22p.

The magnetic deflector system of the Buenos Aires 180 cm synchrocyclotron beam consists of a regenerator and a critical magnetic channel. The channel was built starting on the maximum of the radial oscillation and following a trajectory given by $q = 83.5 + 10\alpha^{3/4}$ (in cm), where (q,α) are polar coordinates with origin at the center of the machine and α is measured from the maximum of the radial oscillation. Alternating gradient magnetic fields were used in order to keep the beam parallel up to the magnetic quadrupole lenses. Thus the vertical divergence of the beam is vanishingly small and the radial divergence is 1/200. With the complete assembly in place 20% of the circulating beam is thrown by the regenerator into the magnetic channel, and its transmission is 10%. The over-all extraction efficiency is therefore 2%. Our information could be useful for the several identical machines in operation or under construction. (auth)

26374 (NP-11889) EL DEFLECTOR MAGNETICO DEL HAZ DEL SINCROCICLOTRON DE BUENOS AIRES. Informe No. 45. (The Magnetic Deflector of the Buenos Aires Synchrocyclotron Beam. Report No. 45). J. Rosenblatt and R. J. Slobodrian (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1960. 22p.

The magnetic deflector system of the Buenos Aires 180-cm synchrocyclotron beam consists of a regenerator (previously reported) and a critical magnetic channel. The channel was built starting on the maximum of the radial oscillation and following a trajectory given by $\rho = 83.5 + 10\,\alpha^{3/4}$ (in cm), where (ρ, α) are polar coordinates with origin at the center of the machine and α is measured from the maximum of the radial oscillation. Alternating gradient magnetic fields were used to keep the beam parallel up to the magnetic quadrupole lenses. Thus the vertical divergence of the beam is vanishingly small and the radial divergence is $1/_{200}$. With the complete assembly in place 20% of the circulating beam is thrown by the regenerator into the magnetic channel, and its transmission is 10%. The over-all extraction efficiency is therefore 2%. (auth)

26375 (TID-16329) THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON. Eighth Quarterly Progress Report, April 1, 1962–June 30, 1962. W. C. Parkinson and R. S. Tickle (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). July 1962. Contract AT(11-1)-921. 6p.

The progress that was made on the design and construction of the University of Michigan 83-inch spiral-ridge cyclotron in the period April 1, 1962, to June 30, 1962, is discussed. (N.W.R.)

26376 (FTD-TT-61-242) ACCELERATORS. COLLECTION OF ARTICLES. Translation of "Uskoriteli. Sbornik Statei" (A publication of the Publishing House of the State Committee for the Utilization of Atomic Energy of the Council of Ministers, Moscow, 1960). 183p.

A total of 15 papers are included for each of which separate abstracts were prepared. Included are papers on linear electron accelerators, betatrons and synchrotrons, and ion sources for cyclotrons. (J.R.D.)

26377 (FTD-TT-61-242(p.1-2)) MOTION OF A PARTICLE IN AN ELECTROMAGNETIC FIELD. S. P. Lomnev. (Translation)

It is noted that problems in physics often reduce to the solution of the equation for motion of a particle in an electromagnetic field such as $(d/d)\bar{p} = \bar{A}(r,\dot{r},t)$ where A is the Lorentz-force factor. It is not always possible to solve this equation for any form of the function A, however by use of computers integration is possible. Experience indicates that many problems concerning particle motion in electromagnetic fields must be checked by numerical integration of a rigorous system using a computer to determine the accuracy of a solution. (J.R.D.)

26378 (FTD-TT-61-242(p.3-21)) RADIAL OSCILLATIONS OF PARTICLES IN A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev and G. A. Tyagunov. (Translation)

Results of an investigation are presented on the nature of particle oscillations in linear electron accelerators in the plane perpendicular to the basic motion, and the relations of these oscillations with the basic motion along the axis. It is found that the equation for particle motion can be conveniently represented as a system of scalar differential equations with the highest-order derivatives separated. It is concluded that it is necessary to ensure that there is no radial magnetic-field component in the initial section of the accelerator. (J.R.D.)

26379 (FTD-TT-61-242(p.22-32)) TRAJECTORY OF PARTICLES IN A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev and G. A. Tyagunov. (Translation)

A system of equations is presented to describe the motion of particles in linear electron accelerators. Several of the values used in the equations are found graphically on the basis of experimental data. Other information and data concerning particle trajectories is presented in discussions of basic variants, initial angular momentum, injection characteristics, and the focusing magnetic field. (J.R.D.)

26380 (FTD-TT-61-242(p.33-6)) FOCUSING PARTICLES BY MEANS OF A PERIODIC MAGNETIC FIELD IN A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev and G. A. Tyagunov. (Translation)

A discussion is presented in which equations are derived and solved to determine an adequate type of focusing; for sufficiently large phase values it is possible to compress the beam in the transverse direction. (J.R.D.)

26381 (FTD-TT-61-242(p.37-42)) FOCUSING A BEAM OF PARTICLES IN A LINEAR ELECTRON ACCELERATOR BY MEANS OF ELECTROMAGNETIC LENSES. S. P. Lomnev and G. A. Tyagunov. (Translation)

A discussion of a focusing system for electron accelerators is presented in which the field is set up by short electromagnetic lenses. (J.R.D.)

26382 (FTD-TT-61-242(p.43-5)) CALCULATION FOR PARTICLE DYNAMICS IN A LINEAR ELECTRON ACCELERATOR WHERE THE FOCUSING MAGNETIC FIELD IS FOUND GRAPHICALLY. S. P. Lomnev. (Translation)

Results of calculations concerning radial oscillations based on 3-Mev accelerator constants are shown. The calculations indicate the need for taking into account the effect of magnetic-field variation on particle dynamics. (J.R.D.)

26383 (FTD-TT-61-242(p.46-53)) PROPORTION OF POWER CARRIED BY ACCELERATING HARMONIC IN A LINEAR ELECTRON ACCELERATOR. S. P. Lomnev. (Translation)

Results are presented of numerical calculations connected with the computation of the fraction of power carried by the basic accelerating (resonant) harmonic in linear electron accelerators. (J.R.D.)

26384 (FTD-TT-61-242(p.54-110)) INVESTIGATION OF ELECTRON ACCELERATION CAPTURE IN BETATRONS AND SYNCHROTRONS. P. A. Ryazin. (Translation)

A discussion of the theory of electron capture during acceleration in betatrons and synchrotrons is presented. The effects of orbit perturbation owing to growth of the magnetic fields, the effects of radial beam space-charge forces, and self-induction of the circular beam current are considered. (J.R.D.)

26385 (FTD-TT-61-242(p.111-28)) INVESTIGATION OF RADIAL OSCILLATIONS OF ELECTRONS IN A BETATRON DURING INJECTION, TAKING INTO ACCOUNT THEIR INTERACTION. A. I. Zaboev (Zaboyev). (Translation)

Development of a microscopic theory of electron capture in betatrons is discussed. It is concluded that from the point of view of this theory the most effective capture pattern may occur on the leading or trailing edges of the injection pulse where Δr may be made quite small owing to the increase in the rate of rise or drop of the voltage on the injector. The capture pattern is less on the flat edge than on the leading or trailing edges. (J.R.D.)

26386 (FTD-TT-61-242(p.129-33)) AN EXAMINATION OF THE ACCURACY OF A SOLUTION TO THE EQUATION OF MOTION OF A PARTICLE IN A BETATRON. S. P. Lomnev. (Translation)

The examination includes consideration of motion equations, radial oscillations, vertical oscillations, and oscillations along ϕ. Results indicate that oscillations in the r direction have a noticeable effect on vertical oscillations, the amplitude being increased and the frequency decreased. A comparison of results obtained by use of rigorous equations with those obtained by approximate formulas is included. (J.R.D.)

26387 (FTD-TT-61-242(p.134-46)) COMPARISON OF PHASOMETER CIRCUITS. N. P. Sobenin. (Translation)

Various types of phasometer circuits are compared for use in measuring the phase velocity in linear electron accelerator waveguides. It is found that any of the phasometer circuits examined permit accurate determination of constant and variable phase velocity for a diaphragm waveguide on the basis of difference measurements. (J.R.D.)

26388 (FTD-TT-61-242(p.151-61)) AN ABSORBING LOAD FOR A DIAPHRAGM-TYPE WAVEGUIDE. N. P. Sobenin and R. K. Gavrilova. (Translation)

Research results are described which indicate that with the aid of metallized plates of wedge shape it is possible to set up linear accelerator traveling-wave operation in any diaphragm-type waveguide. It is noted the area of utilization of the technique is wide. Absorbing loads are recommended for checking the RF response of diaphragm-type waveguides at low power levels. (J.R.D.)

26389 (FTD-TT-61-242(p.147-50)) A NEW METHOD FOR COUPLING A PHASOMETER CIRCUIT TO A DIAPHRAGM-TYPE WAVEGUIDE. N. P. Sobenin. (Translation)

A phasometer design is described for measuring phase velocity variation over the length of bunchers in vacuum-tight diaphragm waveguides. The phasometer is of such high quality that holes normally present in the cell walls through which the signal under investigation may be diverted to the mixer, are not required and the size of the waveguide apertures make no difference in the nature of the variation. (J.R.D.)

26390 (FTD-TT-61-242(p.162-6)) A MASS-SPECTROMETER INSTALLATION FOR INVESTIGATING ION SOURCES. A. I. Nastyukha, I. I. Afanas'ev (Afanas'yev), and L. N. Mikhailov (Mikhaylov). (Translation)

A mass spectrometer is described in which the ion source is at ground potential, while the separation of ions with respect to M/e takes place in a hollow dee to which high voltage is applied that contains a-c and d-c components. Ions from an arc discharge are extracted by an electron which is located between the source and the dee. A negative potential is applied to the electrode. (J.R.D.)

26391 (FTD-TT-61-242(p.167-82)) AN INVESTIGATION OF THE MOTION OF ELECTRONS IN THE MAGNETIC SYSTEM OF AN ELUTRON, TAKING INTO ACCOUNT SCATTERING FIELDS. V. V. Kusnetskii (Kusnetskiy), O. A. Val'dner, V. V. Kotov, and V. N. Chesnokov. (Translation)

Results are described from an investigation concerning the motion of electrons at various energy levels in the magnetic system of a linear-cyclic accelerator (elutron). Included are discussions of the effects of scattering fields on the motion of electrons in the horizontal and vertical planes, and on the phasing properties of the system. (J.R.D.)

26392 POWER PROBLEMS OF THE CERN 28 Gev PROTON SYNCHROTRON. F. Gruetter and E. Hugi (CERN, Geneva). Brit. Power Eng., 5: No. 2, 32-6(July 1962).

Attention is given to the power supply system for the CERN site, the power supply to the synchrotron, the system for power distribution within the synchrotron, and the generator installations at the site. (T.F.H.)

26393 A CALCULATION OF RADIATION EFFECTS ON ELECTRON OSCILLATIONS IN A CIRCULAR ACCELERATOR. C. Pellegrini (C.N.E.N., Frascati, Italy). Nuovo cimento (10), 22: Suppl. No. 2, 603-17(1961). (In English)

Calculation of the radiation effect on electron oscillation in a circular accelerator is first illustrated by a simple example. In the derivation of the equations a harmonic oscillator colliding with particles of an external medium so that it exchanges momentum and energy at random and instantaneously is considered initially. Then the equations of motion of the electrons in a circular accelerator are derived. The equations derived are valid for strong-focusing non-isomagnetic machines that are now considered as possible storage devices as they can have damping on all three modes of oscillation. (J.S.R.)

26394 ON THE RELATIVISTIC ELECTRON MOTION IN A MAGNETIC FIELD TRAVELING WITH PHASE VELOCITY FASTER THAN THE SPEED OF LIGHT. Yu. P. Rybakov. Vestnik Moskov. Univ., Ser. III, No. 2, 3-10 (Mar.-Apr. 1962). (In Russian)

An analysis is made of one of the possible variations of linear induction accelerators with magnetic fields traveling at speeds exceeding the velocity of light. The inducted electron energy, radiation, and motion stability are calculated. (R.V.J.)

26395 AN EXPERIMENTAL INVESTIGATION OF THE SIZE OF AN ELECTRON BUNCH DURING A SPECIAL MODE OF OPERATION OF A SYNCHROTRON. O. F. Kulikov and P. B. Shoshin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 42: 1461-3(June 1962). (In Russian)

The variation of radial and axial dimensions of an electron bunch on the ascending and descending parts of the magnetic cycle of the C-25 FIAN synchrotron is investigated. A larger increase of the radial oscillation amplitude on the descending part of the magnetic cycle as compared to that calculated theoretically, was indicated. (auth)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 25960, 25961, and 25962.

26396 (AD-268824) RADAR CROSS-SECTION OF LOW ELECTRON DENSITY PLASMA BODIES OF ARBITRARY SHAPE. Research Note No. 36. Srbislav Zivanovic (Bendix Corp. Bendix Systems Div., Ann Arbor, Mich.). June 30, 1961. Contract DA-11-022-ORD-3130. 19p.

The radar cross-section of arbitrary shapes of low-density plasma bodies for variable electron density is discussed. An approximation for the case when the wave length is much greater than the largest dimension of the reflecting body is obtained, and the radar cross-section and shape factor for a sphere, cone, and cylinder are derived. (auth)

26397 (AD-269051) THE ELECTROSTATIC INSTABILITY OF A BEAM OF CHARGED PARTICLES PENETRATING A PLASMA. G. Ascoli (Illinois. Univ., Urbana. Coordinated Science Lab.). Dec. 1961. Contract DA-36-039-SC-85122. 28p. (R-131)

The stability of an infinite beam of charged particles penetrating a plasma against small amplitude electrostatic perturbations was investigated. The dispersion relation was derived, taking into account the velocity distribution of the beam particles. It is shown that in the presence of collisions the electrostatic instabilities can be quenched if the beam particles have a velocity spread. The results were applied to a beam of finite cross section held together by its own magnetic field. The criteria for the stability of such a beam against electrostatic perturbations was derived. (auth)

26398 (AD-270033) THERMAL EFFECTS ON PLASMA DISPERSION RELATION BY SUPERPOSITION OF STREAMS. Lewis M. Linson (Aerospace Corp. Physical Research Lab., El Segundo, Calif.). Aug. 10, 1961. Contract AF04(647)-930. 14p. (TDR-930(2210-04)-TN-1)

The derivation of the thermal effects on the dispersion relation for the propagation of both transverse and longitudinal waves in an unbounded, collisionless plasma is derived in a consistent and straightforward manner by the method of superposition of streams. The assumptions made are explicit, and the applicability to other more particular cases is obvious. A comparison is made with results obtained by other authors, and the differences, where they occur, are explained. The relation of this method with a more common method is pointed out, together with pitfalls to be avoided. (auth)

26399 (AD-270635) ELECTROMAGNETIC WAVES IN LONGITUDINALLY MAGNETIZED FERRITES BETWEEN TWO CONDUCTING PARALLEL PLANES. Report 1021-10. H. Unz (Ohio State Univ. Research Foundation. Antenna Lab., Columbus). Dec. 1, 1961. Contract AF33(616)-6782. 44p.

The electromagnetic waves propagating in longitudinally magnetized homogeneous ferrites, between two perfectly conducting parallel planes, were investigated, by using the operational calculus method. The solution separates into two sets of independent hybrid modes of even symmetry and odd symmetry. Two independent transcendental equations for the propagation constant were found and the field

components were evaluated. For the isotropic case, the hybrid-mode solution degenerates to the TE and TM waves of the corresponding symmetry. Results are in agreement with the ones found previously by Suhl and Walker (Phys. Rev., 86: 122-123, 1962) and by Epstein (Rev. of Mod. Phys. 28.1: 3-17, 1956), using a different method. (auth)

26400 (D1-82-0172) INJECTED PLASMAS IN INDIUM ANTIMONIDE IN THE PRESENCE OF LONGITUDINAL MAGNETIC FIELDS. Betsy Ancker-Johnson (Boeing Scientific Research Labs., Seattle). June 1962. 20p.

The properties of injected electron-hole plasmas were investigated as a function of current I, electric field strength E, and longitudinal magnetic field strength B. A boundary in E-B space exists below which the plasma density remains essentially equal to the density obtained in the absence of an external magnetic field. In the regime $B > B_{critical}$ above the boundary the plasma is strongly dissipated. Oscillations occur in the subcritical regime only for high currents, $I > I_{pinch}$. These "pinch-unpinch" oscillations have a nonreproducible waveform. Very reproducible oscillations were observed in the supercritical regime and their threshold frequencies were measured (a typical value is 25Mc). The data were compared to the predictions of the hydromagnetic screw instability theory. Agreement was found for the dependence of the critical electric field strengths and the threshold frequencies on the critical magnetic field strengths. Qualitative agreement required that the diameter of the injected plasma column be more than an order of magnitude smaller than the transverse dimensions of the sample. There were also some results which are inexplicable on the basis of the screw instability theory. Essentially infinite conductivity occurs in magnetic fields $> B_{crit}$ at electric field strengths less than the impact ionization threshold. The plasma density is so greatly reduced by a longitudinal magnetic field that the reduction cannot be caused only by a perturbation, e.g., a reduction of 75% in 400G at 270v/cm. (auth)

26401 (JINR-P-917) O VOZBUZHDENII ELEKTROMAGNITNYKH VOLN V PLAZME, GDE ELEKTRONY IMEYUT NAPRAVLENNUYU SKOROST OTNOSITEL'NO IONOV. (On the Excitations of Electromagnetic Waves in Plasma with Oriented Electron Velocity in Relation to Ions). V. G. Makhan'kov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 5p.

Studies of electromagnetic wave excitation in an unlimited system consisting of ions and electrons moving in an external magnetic field show that excitation and propagation perpendicular to the electron waves, without fulfilling Cherenkov conditions, is possible. (tr-auth)

26402 (JINR-P-929) O SILOVYKH LINIYAKH MAGNITNOGO POLYA. (On Magnetic Field Power Lines). V. K. Mel'nikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 9p.

An attempt was made to find power line distributions in order to evaluate plasma motion in a given magnetic field. An approximation was developed for a vortex-free magnetic field with a specified scalar potential $H_0 z + 4(x,y,z)$, where H_0 is a constant and the function $4(x,y,z)$ satisfies the Laplace equation with periodicity along z, with a 2π period, and with $\int^{2\pi} 4(x,y,z)dz = 0$. Various power line possibilities are analyzed. (R.V.J.)

26403 (PAN-301/XVIII) THE DESIGN AND CONSTRUCTION OF MAGNETIC FIELDS FOR PLASMA RESEARCH. Michał Gryziński and Marek Sadowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 13p.

The main problems arising during the design and construction of medium size air-core electro-magnets are discussed. The basic equations are given relating magnetic field strength, magnetic field rise time, power input, electrodynamic forces, and thermal conditions e.g., allowable temperature rise to give the detailed dimensions required for the electrical conductor and the cooling annuli. The details for a 25 kgauss sectional oil-cooled electromagnet for plasma research are described. (auth)

26404 (RAD-TR-61-13) ULTRASONIC TEMPERATURE DETERMINATIONS IN A PLASMA. Edmund H. Carnevale, Howard L. Poss, and Jerrold M. Yos (Avco Corp. Research and Development Div., Wilmington, Mass.). June 19, 1961. 25p. (AD-269363)

An ultrasonic pulse technique for measuring gas temperatures in an internal combustion engine was used to determine temperatures in an electric arc plasma jet. Measurements of sound velocity at one mc per sec were obtained in high-temperature air, argon, and helium at atmospheric pressure. Temperatures are calculated from these sound speeds on the assumption that only the translational and rotational degrees of freedom are excited by the sound wave, while vibration, dissociation, and electronic excitation remain frozen. The temperatures determined in this way range from 3500 to 8000°K. In the case of the air arc, the ultrasonic temperature measurements are compared with temperatures determined from an energy balance on the plasma jet. The average temperatures obtained by the two methods agree within 10% over the temperature and enthalpy range considered. The results also show that temperature fluctuations as high as 50% can occur during a given arc run. A discussion of the experimental apparatus, method of measurement, experimental results, and analysis is included. (auth)

26405 (UCRL-10128) PROBE THEORY IN A DENSE PLASMA. G. Ecker, K. S. Masterson, and J. J. McClure (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 21, 1962. Contract W-7405-eng-48. 33p.

A dense plasma is defined as one in which the effective mean free path of one particle component is small in comparison with the probe dimensions; thus Langmuir's theory is not applicable in such a plasma. The presence of the probe causes marked changes of density and potential distributions in the probe environment. These effects were calculated for insulated probes of various geometries. An exact solution is given for a concentric cylindrical probe. For more general geometries, an appropriate approximation procedure, the composition method, was developed from variational principles. The effect of probe disturbances on the measurements can be accounted for in terms of an effective probe position and a potential correction. Introduction of the probe also causes changes in the eigenvalue and electron temperature. The results allow one to unfold experimental data to find the true plasma qualities. Consideration of the inertia-limited region shows that Bohm's criterion is not suitable to judge either the stability or stationarity of the sheath. A stationary inertia-limited region can exist only under certain restricted circumstances. (auth)

26406 (NP-tr-883) KINETIC THEORY OF RAPIDLY VARIABLE PROCESSES IN A PLASMA. V. P. Silin (Akademiya Nauk S.S.S.R. Institut Fiziki im. P. N. Lebedeva). Translated by John R. Shaw (Boeing Scientific Research Labs., Seattle). 1961. 42p.

A kinetic equation was obtained for a gas of particles with weak interaction suitable for the description of rapidly variable processes. The equation was derived for rapidly variable processes in a nonrelativistic plasma and then

the corresponding equation was found for the case of relativistic particles. The application of the equation to the theory of the high-frequency dielectric permeability of a plasma was examined. (M.C.G.)

26407 STABILITY OF PERIODIC PROCESSES IN PLASMA. I. Štoll (Inst. of Nuclear Physics, Czechoslovak Academy of Sciences, Řež). Československ. časopis pro fysiku, 3A: 252-71(1962). (In Czech)

A survey is given of some of the results and physical concepts concerning wave processes in plasma. The question of the instability of oscillations caused by deviations from the isotropic Maxwell velocity distribution is dealt with. Of the theoretical methods, particular attention is paid to the so-called drift approximation corresponding to the resolution of the solution in powers of a (strong) magnetic field. (auth)

26408 EXPERIMENTAL VERIFICATIONS OF THE REDUCTION OF SCATTERING LOSSES AND OF CONTAINMENT BY THE SUPERPOSITION OF HF AND STATIC MAGNETIC FIELDS. Térenzio Consoli and René Le Gardeur. Compt. rend., 254: 3323-5(May 7, 1962). (In French)

In a preceding article (Compt. rend., 254: 3188(1962)), an expression of the force exerted on a plasma confined by static magnetic and stationary electromagnetic fields in a spherical cavity was given. Experimental results which confirm the existence of this force are reported. (tr-auth)

26409 RESULTS OF THERMONUCLEAR RESEARCH. III. Ferenc Beleznay and Gyula Hargittay. Fiz. Szemle, No. 8, 251-6(1961).

Methods of measuring the excitation temperature of plasma and various possibilities of heating plasma to the desired temperature in power reactors are described. Investigations show that in a rather long time a state of equilibrium develops in the plasma to which a definite temperature and degree of ionization may be assigned. The electron temperature may be determined from the continuous spectrum of recombination radiation. Spectroscopic and acoustical methods for measuring the excitation temperature are described. Plasma heating methods described include those involving Ohm's Law and magnetic pumps. Experience shows that the magnetic pumping methods are most expedient. (OTS)

26410 DIELECTRIC CONSTANT OF A PLASMA. R. N. Franklin (Royal Military Coll. of Science, Shrivenham, Eng.) and G. Francis. J. Electronics and Control, 11: 54 (July 1961).

Calculation of plasma dielectric constants (J. W. Gallop, et al., J. Electron Contr., 10: 207(1961)) is discussed. In using the electromagnetic approach, the field in the medium includes the effect of charge separation. In considering a plasma between the plates of a condenser, the same expression for the dielectric constant results if the effect of charge separation is properly included. (L.N.N.)

26411 PLASMA ELECTRON OSCILLATION AND CONCENTRATION PATTERNS. K. G. Emeleus and A. Garscadden (Queen's Univ., Belfast). J. Electronics and Control (1), 12: 393-4(May 1962). (In English)

In probe investigations of low-pressure discharges in which plasma-electron oscillations are taking place, curves showing the electron concentration as a function of position exhibit structure are given. This structure usually takes the form of concentration depressions near the positions at which the strongest oscillations are detected. It is found that some of this structure is not real, but arises as a result of partial falsification of probe analyses. This falsification is a result of oscillating fields in the plasma. In experiments in which the probe disturbance is reduced to a minimum, it is found that much of the structure is real. Even in these experiments, however, there is evidence that the probe may produce or stabilize standing wave patterns. (T.F.H.)

26412 ELECTRODE PHENOMENA IN MAGNETOHYDRODYNAMIC POWER GENERATION. D. W. George and H. K. Messerle (Univ. of Sydney). Nature, 195: 276-7(July 21, 1962).

High conductivities were obtained with cold electrodes in air plasmas produced by an electrically driven shock tube. No carbon was present, refuting the explanation of Maycock, Noe, and Swift-Hook for their results. The resistance between the two electrodes at high current densities (on the order of 50 amp/cm^2) corresponds to the electronic conductivity of the air plasma, but at lower current densities the resistance is much higher. It is suggested that collision ionization occurs in a thin gas layer adjacent to the cathode when the field strength is high enough. The possibility of using cooled electrodes and this secondary ionization effect for magnetohydrodynamic power generation is discussed. (D.L.C.)

26413 SOME COMMENTS ON THE LANDAU DAMPING. A. Kildal (Univ. of Bergen). Nuovo cimento., 24: 1107-16 (June 16, 1962). (In English)

The behavior of electrons in a linear, longitudinal wave is discussed, with emphasis on the resonant electrons. The mean spatial value of the energy absorbed by the resonant electrons is calculated, as well as the mean value of the wave's energy density. An expression for the damping factor is found. The physical meaning of analytic continuation of functions appearing in the theory is explicitly shown. (auth)

26414 COMMENT ON "PLASMA MOTION ACROSS MAGNETIC FIELDS." Harold P. Furth (Univ. of California, Livermore). Phys. Fluids, 4: 787-8(June 1961). (UCRL-6294)

In discussions of plasma acceleration in two-stage accelerators, it is shown that when there is no passage of particles into or out of electrodes very little acceleration of plasma results. It is noted, however, that the fraction of the plasma which must pass into and out of the electrodes during acceleration to avoid charge separation can be kept small in experimental situations. The gross behavior of rotating plasmas, pinches, and rail-type accelerators appears to be so little affected by electrode phenomena that these can be neglected entirely for most theoretical purposes. (J.R.D.)

26415 THE THEORY OF IRREVERSIBLE PROCESSES AND PLASMA PHYSICS. Joergen B. Knoff (Institut d'Astrophysique, Paris). Phys. Letters, 1: 229-30 (June 15, 1962). (In English)

Following the theory of irreversible processes, the case of a multi-component, ionized fluid, supposedly anisotropic with symmetry of revolution around the magnetic field lines, is investigated. The adoption of the two-fluid model imposes strict conditions on the thermodynamical properties involved; validity of the approximation is severely limited. Conclusions are confirmed by the Chapman-Enskog theory in the linear approximation. (L.N.N.)

26416 COLLISION DAMPING OF PLASMA OSCILLATIONS. D. F. DuBois, V. Gilinsky, and M. G. Kivelson (RAND Corp., Santa Monica, Calif.). Phys. Rev. Letters, 8: 419-21(June 1, 1962).

Assuming alternatively that a plasma may be composed of electrons and ions, or of an electron gas in a uniform

positive background, calculations are made of the rate of collision damping (i.e., of plasmon decay into a two-particle final state). Collision damping is found to be the main damping mechanism for all but very short wavelengths. (T.F.H.)

26417 GENERATION OF A HOT, DENSE PLASMA BY A COLLECTIVE BEAM-PLASMA INTERACTION. L. D. Smullin and W. D. Getty (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 9: 3-6(July 1, 1962).

Plasma was produced using a pulsed electron beam. The plasma was generated primarily by energetic plasma electrons receiving energy from strong oscillations resulting from interactions between the electron beam and the plasma. These oscillations use part of the beam's d-c kinetic energy to produce and heat a plasma. (L.N.N.)

26418 MICROWAVE EMISSION AND ABSORPTION AT CYCLOTRON HARMONICS OF A WARM PLASMA. G. Bekefi (Massachusetts Inst. of Tech., Cambridge), J. D. Cocoli, E. B. Hooper, Jr., and S. J. Buchsbaum. Phys. Rev. Letters, 9: 6-9(July 1, 1962).

Microwave emission from and absorption by a plasma column in a magnetic field were measured. The plasma frequency ω_p was greater than or about equal to the microwave radian frequency ω, and the electron collision was much less than ω ($10^{-4} \leq \nu/\omega \leq 10^{-1}$). Measured magnitudes and spectra of emitted and absorbed radiation differed from theory predicted from models of an infinite, uniform plasma near thermal equilibrium. Magnitudes of emission and absorption lines of electron cyclotron harmonics were several orders of magnitude greater than those calculated for warm plasma having a Maxwellian distribution of electron velocities; line shapes were usually not Lorentzian. (L.N.N.)

26419 RESONANT BEHAVIOR OF A CYLINDRICAL COLUMN OF PLASMA IN FREE SPACE WITH AND WITHOUT STEADY MAGNETIC FIELDS. A. M. Messiaen and P. E. Vandenplas (Ecole Royale Militaire, Brussels). Physica 28: 537-52(June 1962).

After a discussion of microwave scattering measurements in free space, it is experimentally shown that the secondary resonance peaks of a cylindrical column are not appreciably affected by the waveguide-plasma distance. Data concerning resonance frequencies and amplitudes are given for a steady uniform magnetic field acting in three rectangular directions. When the magnetic induction is parallel to the axis of the cylinder, partial comparison between theory and experiment is possible. (auth)

26420 EQUATIONS OF PLASMA MAGNETODYNAMICS. A. Hruška. Pokroky mat., fys. a astron., No. 3, 308-26 (1960).

Various equations are described for plasma magnetohydrodynamics in order to solve problems involving magnetohydrodynamic laws. The micro-pole is analyzed and used in determining the laws of the microscopic units. The difference between plasma and neutral gas is explained in terms of coulomb interaction. Charged particle movement in a homogeneous magnetic field is equated. The continuity and Maxwell electromagnetic equations are also derived. Other equations involving relaxation time and interactions are described. (OTS)

26421 ON THE INITIAL STAGES OF A PINCH DISCHARGE. N. J. Phillips (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 80: 307-9(July 1, 1962).

The processes and mechanisms dominating a cylindrical pinch, during the time in which the plasma is being formed at the cylinder walls and is beginning to move toward the axis, are studied. It is found that there is a tendency for the total number of electrons in the current sheet at the wall to be self-limiting, because as this number rises, the force pulling the current sheet from the wall also rises. This tendency is particularly expected at large initial electric-field/pressure ratios. It is suggested that if the total number of electrons is not large enough, the imploding current sheet may be porous to the neutral gas within the sheet. This situation implies poor gas trapping characteristics for the z-pinch. (T.F.H.)

26422 ASYMPTOTIC BEHAVIOUR OF ADIABATIC INVARIANTS. Yôiti Watanabe (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 653-64(Apr. 1962). (In English)

The asymptotic expansion of Liouville's distribution in a one-dimensional system is investigated. The expansion leads to the adiabatic theorem with respect to the action integral. The first-order invariance with respect to the slowness parameter ϵ involved in the external distortion is explained in terms of the canonical mapping between two energy curves in the phase plane but at two different instances, which may be found in the one-dimensional system between those two curves having a common area. The canonical mapping determines the mechanism of the external distortion and yields the second-order invariance of the mean action integral when the action integral is averaged over all possible phases at a fixed initial energy, the distortion being imposed on or released from the system in a sufficiently smooth manner. (auth)

26423 COMPLEX DIELECTRIC CONSTANT OF ELECTRON FLUID. Setsuo Misawa (Nihon Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 27: 840-2(Apr. 1962). (In English)

A solution of the kinetic equation in L. D. Landau's Fermi liquid theory (J. Exp. Theoret. Phys. U.S.S.R., 30: 1058(1956)) is presented. If the Yukawa potential is adopted as the crudest approximation for the correlation function of the Coulomb interaction, an expression giving only the plasma frequency with the exchange effect is obtained. The surface impedance in the region of extreme anomalous skin effect is obtained. (L.N.N.)

26424 INTERACTION OF AN ELECTRON BEAM WITH A PLASMA. M. F. Gorbatenko. Ukrain. Fiz. Zhur., 7: 233-43(1962). (In Russian)

In the hydrodynamic approximation, the excitation of a finite plasma by a finite electron beam in the absence of an external magnetic field is considered. In the limiting case of a beam the instability conditions and the limiting length of the waves are obtained, and the increments of the excited oscillations in the beam-plasma system are calculated. The excitation conditions and the increments differ most radically from the corresponding values for an unlimited beam in an unlimited plasma in the case when the radii of the plasma and the beam are substantially smaller than the wave-length in the system. (auth)

26425 APPROXIMATE FORMULAE FOR THE INTENSITY OF DIFFUSE RADIATION EMITTED FROM A PLANE LAYER OF A TURBID MEDIUM. E. G. Yanovitskii. Ukrain. Fiz. Zhur., 7: 297-304(1962). (In Russian)

Approximations are derived for certain functions φ and ψ for certain cases of the simplest type of aspherical indicatrix of diffusion. Knowing the functions $\varphi(\eta)$ and $\psi(\eta)$ permits: given the optical parameters of the medium and the illumination created directly by the source of "exciting"

radiation, the determination of the intensity of radiation diffusely reflected and diffusely transmitted by the plane layer of a turbid medium; and also, given the illumination intensity and the angular distribution of the intensity of diffuse radiation, calculation of the optical parameters of the medium. Approximate analytical expressions are found for the zeroth and first moments of $\varphi(\eta)$ and $\psi(\eta)$, which permits writing down analytical relations for the intensity of diffuse radiation emitted from a medium contiguous with an isotropically reflecting surface with a given albedo. A comparison of the values of the functions $\varphi(\eta)$ and $\psi(\eta)$ calculated by the approximate formulas derived with the exact values indicates the precision of the approximate formulas. (auth)

26426 ON A KINETIC EQUATION FOR AND THE DYNAMICAL FRICTION OF A PARTICLE IN A PLASMA–A PHENOMENOLOGICAL APPROACH. S. V. Yadavalli (Stanford Research Inst., Menlo Park, Calif.). Z. Physik, 167: 525-32(1962). (In English)

Based on phenomenological considerations, a one-particle distribution function consisting of two parts accounting for the effects of "distant" particles and the "nearest" neighbors is suggested. Employing the above distribution function and the Liouville theorem, dynamical friction of a particle in, and a kinetic equation for, a plasma are demonstrated. (auth)

26427 EXCITATION OF OSCILLATIONS UPON PASSAGE OF A SLOW ION BEAM THROUGH A PLASMA. M. D. Gabovich and G. S. Kirichenko. Zhur. Eksptl'. i Teoret. Fiz., 42: 1478-80(June 1962). (In Russian)

Cesium ions produced on the surface of an incandescent probe and accelerated in the layer surrounding it were introduced in a plasma. In accordance with theoretical predictions, the passage of a beam of slow ions through a plasma was accompanied by excitation of low-frequency oscillations. (auth)

26428 ON THE NONLINEAR THEORY OF INTERACTION BETWEEN CHARGED PARTICLE BEAMS AND A PLASMA IN A MAGNETIC FIELD. V. D. Shapiro and V. I. Shevchenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 42: 1515-28(June 1962). (In Russian)

The back actions of oscillations excited as a result of interactions between charged-particle beams and electron plasma in magnetic fields is considered. An equation is derived describing the change of the initial nonequilibrium function for the beam and plasma caused by the interaction with the plasma oscillations. The change in the mean velocity and beam temperature due to instabilities caused by the Vavilov–Cherenkov effect and also by the anomalous and normal Doppler effects is determined. (auth)

26429 DISTRIBUTION FUNCTIONS OF AN ELECTRIC MICROFIELD IN AN IONIZED GAS. V. N. Alyamovskii (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 42: 1536-42(June 1962). (In Russian)

The distribution functions for the electric microfield of a plasma can be expressed exactly in terms of pair correlation functions for Coulomb particles and a dipole in the plasma. The case of a high-temperature plasma is considered in the self-consistent field approximation. The distribution function for the potential energy of a charge in the microfield of a plasma is derived in the same approximation. In this approximation, the effect of particle correlation is essentially equivalent to cutting off the Coulomb potential at the Debye length. (auth)

26430 ONE-DIMENSIONAL MOTION OF THERMALLY INEQUILIBRATE PLASMA. V. M. Sarychev. Zhur. Prikl. Mekh. i Tekh. Fiz., No. 3, 15-20(May-June 1962). (In Russian)

The one-dimensional stationary propagation of a two-component plasma in a channel free of external electric and magnetic fields was studied. It is shown that the plasma motion is similar to the motion of an ordinary gas with a molecular weight identical to the plasma weight a and temperature equal to the sum of the temperatures of the electron and ion components. The problem of plasma motion in a channel with constant cross section and with a uniform ion temperature along the channel is considered. (R.V.J.)

26431 ONE DIMENSIONAL UNSTABLE FLOW OF ELECTRICALLY CHARGED GAS AT ZERO PRESSURE. V. A. Levin. Zhur. Priklad. Mekh. i Tekh. Fiz., No. 3, 21-6(May-June 1962). (In Russian)

Precise solutions are found for certain one-dimensional unstable oscillations of cold plasma. (tr-auth)

Shielding

26432 (APEX-652) HAND CALCULATION OF NEUTRON FLUX. J. T. Lence, R. R. Liguori, and Andrew Lowery (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). July 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 33p.

Data on neutron flux distributions were obtained for a large number of shielding configurations. In shield tests, foils were exposed so that fluxes might be separated into a sub-cadmium flux, an epi-cadmium flux, and one or two fast fluxes. The objective was to develop simplified hand calculations to approximate these experimental results. (auth)

Theoretical Physics

Refer also to abstract 25964.

26433 (JINR-E-975) QUANTUM ELECTRODYNAMICS IN TERMS OF ELECTROMAGNETIC FIELD STRENGTHS. V. I. Ogievetskij and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 9p.

The Lorentz-invariant formulation of quantum electrodynamics is given, which does not involve potentials but electromagnetic field strengths only. (auth)

26434 (JINR-E-977) ON A REGULARIZATION METHOD IN THE FIELD THEORY. M. A. Markov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 17p.

The S-matrix was constructed by using the functions which go over into the plane waves at $t \to \pm\infty$ instead of the plane waves. The notion of the "free" field quantum corresponds to that of the free particle only at $t \to \pm\infty$. The formalism was constructed as follows: an ordinary free field $\phi^0(x)$ is supplemented with a certain "counter-field" which is damping with time, quantized according to the indefinite metric (with an "opposite sign") and makes the regularization of the Δ functions. The quanta of the "counter-field" $\phi'(x)$ vanish at $t \to \pm\infty$. The counter-field does not make any contribution to the probabilities and the cross sections of the observable effects. The theory is causal, unitary, and relativistic invariant. (auth)

26435 (JINR-P-906) S-MATRISTA DLYA ODNOMERNOGO URAVNENIYA SHREDINGERA I EE ASIMPTOTIKA V

KVAZIKLASSICHESKOI OBLASTI. (S-Matrix for One-Dimensional Schroedinger Equation and its Quasi-Classical Asymptotic Behavior). S. N. Sokolov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 15p.

A regular method is proposed for the direct calculation of the S-matrix for the one-dimensional Schroedinger equation. The method stays effective in case of the wide interaction regions $\gg\lambda$ and is applied to the investigation of the quasi-classical asymptotic behavior of the overbarrier reflection from arbitrary potentials. The asymptotic behavior is shown to be largely dependent on the continuity of the high derivatives of the potential. (auth)

26436 (FTD-TT-62-354) CONCERNING REIMANN WAVES. N. V. Saltanov and V. S. Tkalich. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekhan. i Mashinostr., No. 6, 26-32(1961). 14p.

Riemann waves were investigated in gas dynamics. Equations were derived and general solutions given. (M.C.G.)

26437 ON THE GENERAL INTEGRAL REPRESENTATION OF PERTURBATION EXPANSION OF SCATTERING AMPLITUDE AND ITS RELATION TO NAMBU-SYMANZIK REPRESENTATION. W. Garczyński (Wrocław Univ., Poland). Bull. acad. polon. sci., Sér. sci., math., astron. et phys., 10: 171-6(1962). (In English)

General parametric representations for the perturbation expansion of the scattering amplitude are given. Relations to parametric representations given by Y. Nambu (Nuovo Cimento, 6: 1064(1957)) and K. Symanzik (Prog. Theor. Phys., 20: 690(1958)) are discussed. (L.N.N.)

26438 ON THE FORMULATION OF THE DYNAMICAL LAWS IN THE QUANTUM THEORY OF FIELDS. P. Kristensen. Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd., 33: 1-32(1962). (In English)

A formulation of the dynamical laws for a system of elementary particles is proposed. In addition to simple assumptions of a kinematical nature, the formulation rests on the principle that a classical field and classical sources which, according to the classical theory, describe the same physical situation, also do so when the classical system is coupled to a quantum field. For the Hurst-Thirring field, this principle may be formulated in finite mathematical terms and may serve as a substitute for the formal field equation of the renormalization theory. To the third order in the coupling constant — and presumably to all orders — the perturbation expansion gives the same result as the usual theory. No infinities or similar mathematical ambiguities appear. (auth)

26439 QUANTUM THEORY OF MEASUREMENT AND ERGODICITY CONDITIONS. A. Daneri (Università, Milan), A. Loinger, and G. M. Prosperi. Nuclear Phys., 33: 297-319(May 1962). (In English)

Some criticisms to von Neumann's treatment of the measuring process are discussed. The problem is considered and investigated on the basis of an ergodic theorem. The measuring apparatus is schematized as a macroscopic system which possesses, besides the energy, at least another macroscopic constant of the motion. The value of this constant characterizes an invariant manifold ("channel"). In each manifold certain ergodicity conditions hold and there exists an equilibrium macro-state towards which the system evolves spontaneously. The apparatus is assumed to be initially in the equilibrium state belonging to a given channel and the interaction with the observed system determines a transition of the apparatus towards a state belonging to another channel, which depends on the initial state of the observed system. Then the apparatus evolves towards a new equilibrium state. The ergodicity conditions employed are sufficiently realistic, since it is proved that they are in particular satisfied by a certain class of Hamiltonians for which a master equation can be derived. (auth)

26440 PAIR DISTRIBUTION FUNCTIONS AND SCATTERING PHENOMENA. L. Van Hove and K. W. McVoy (CERN, Geneva). Nuclear Phys., 33: 468-76(May 1962). (In English)

Consequences of relations between the compressibility of a many-body system, its density fluctuations, its pair distribution, and its scattering properties are discussed, and are applied to the case of a system in its ground state, with special reference to atomic nuclei. (auth)

26441 A REFORMULATION OF THE QUANTAL N-PARTICLE PROBLEM BY MEANS OF REDUNDANT COORDINATES. A. Kihlberg (Chalmers Univ. of Tech., Goteborg). Nuclear Phys., 35: 645-53(July 1962). (In English)

The Hamiltonian for the N-particle problem is transformed by means of redundant coordinates. A rigorous separation of the barycentric motion is thus obtained. The spurious states are easily identified and can be eliminated by multiplying the wave functions by a characteristic function. Finally the transformed Hamiltonian suggests the use of 2-particle wave functions for the approximation of the true wave function. The possibility of carrying out a perturbation expansion is considered in an example. In scattering theory this "Ansatz" leads to the impulse approximation. (auth)

26442 FIELD PROPAGATORS SINGULAR AT ZERO COUPLING. J. A. Swieca (Univ. of São Paulo, Brazil). Nuclear Phys., 35: 686-93(July 1962). (In English)

The asymptotic equivalence, for vanishing coupling, between axiomatic and ghost propagators is investigated. The physical implications of such an equivalence for the singular structure of a field theory and for the high energy properties of field propagators are discussed. (auth)

26443 A GENERALIZATION OF FIELD QUANTIZATION AND STATISTICS. S. Kamefuchi (Imperial Coll. of Science and Tech., London) and Y. Takahashi. Nuclear Phys., 36: 177-206(July 1962). (In English)

An attempt is made at generalizing commutation relations of creation and annihilation operators in field theory. The algebra for these operators is determined such that they form a basis of representations of either an infinite-dimensional rotation group (R-type) or an infinite-dimensional symplectic group (S-type). The former case leads to a generalized Fermi-Dirac statistics in the sense that at most n_{max} particles can occupy one and the same state, where n_{max} is any positive integer. The latter corresponds to a generalization of the Bose-Einstein statistics. General properties of many-particles state vectors are investigated. One of the characteristic features in such a theory is that many-particle states show a new kind of degeneracy and form the basis of representations of symmetric group which correspond to the Young diagrams with many rows and columns. In the relativistic field theory the former method (R-type) can be applied only to fields with half-integer spin, whereas the latter method (S-type) can be applied only to fields with integer spin. (auth)

26444 STOCHASTIC LORENTZ OBSERVERS AND THE DIVERGENCES IN QUANTUM FIELD THEORY. R. L. Ingraham (New Mexico State Univ., University Park). Nuovo cimento, 24: 1117-46(June 16, 1962). (In English)

Sharp space-time coordinates x are replaced by sto-

chastic space-time coordinates X, with means x and dispersion measured by a universal length λ, as the kinematical basis of Lorentz classical or quantum covariant field theories. It is found that 4-dimensional distributions are not possible, but 3-dimensional (unsharp rods, sharp clocks) and 1-dimensional (unsharp clocks, sharp rods) distributions are allowed. Lorentz invariance and the feature of nonzero dispersion together imply that a given physical field can be represented by an infinity of (in general, slightly different) tensor fields, one for each equivalent observer. Some consequences of this idea in quantum field theory are investigated. It results, generally speaking, in high momentum cut-offs in some expressions. For free fields the invariant functions turn out to be continuous and bounded; a "skin effect" violation of microcausality is present in the exterior of the light cone. For interacting fields the iteration solution S-matrix is unambiguous (no subtraction formalism) and has only finite matrix elements. The renormalization idea that self-energy parts, etc., can only renormalize bare-particle parameters must, strictly speaking, be given up. Corrections to "point particle" scattering arise in the form of form factor functions of momentum transfers q. These are not functions of q^2 only, as in some ad hoc theories. The "standard deviation" λ is estimated to be a nucleon Compton wave length or smaller. (auth)

26445 APPROXIMATION METHODS IN CLASSICAL STATISTICAL MECHANICS. J. K. Percus (New York Univ., New York). Phys. Rev. Letters, 8: 462-3(June 1, 1962).

The pair distribution function for a classical fluid in thermal equilibrium is found to be more closely approximated by the Percus and Yevick (Phys. Rev., 110: 1(1958)) approximation than by the Bogoliubov-Born-Green-Kirkwood-Yvon (B.B.G.K.Y.) approximation or the hypernetted-chain approximation. It is noted that the reason for this finding lies in the fact that the Percus and Yevick approximation chooses a quite advantageous function for making a Taylor expansion of the appropriate equation for a grand canonical ensemble. (T.F.H.)

26446 HIGH-ENERGY LIMIT OF SCATTERING AMPLITUDES. E. Predazzi, T. Regge, and C. Rossetti (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Phys. Rev. Letters, 8: 493-4(June 15, 1962).

For high-energy scattering through a fixed angle (Θ), away from the region of the diffraction peak, the scattering amplitude A is derived as a function of ξ, where ξ is a linear combination of the Mandelstam variables s, t, and u. The resulting expression for A, in the limit as ξ approaches infinity, is: $A(\xi,\Theta) \cong \lambda_1(\Theta) + \lambda_2(\Theta)\xi^{-2}$, where λ_1 and λ_2 are constants. The properties of this asymptotic expression for A are discussed. (T.F.H.)

26447 REMARK ON DIFFRACTION SCATTERING. Graham Frye (Univ. of Washington, Seattle). Phys. Rev. Letters, 8: 494-7(June 15, 1962).

Under the primary assumption that inelastic processes dominate high-energy behavior, and the secondary assumptions that the asymptotic behavior of the absorptive part is factorable in a certain way and that the position α(t) of the Regge poles increases monotonically for t (invariant momentum transfer)<0, it is shown that the elastic and total cross sections at high energies increase logarithmically and that the total/elastic cross section ratio approaches the value 4. This result is incompatible with the hypothesis that the total cross section approaches a finite constant at high energies. (T.F.H.)

26448 DEGREE OF APPROXIMATE VALIDITY OF THE ADIABATIC INVARIANCE IN QUANTUM MECHANICS. L. M. Garrido (Universidad de Barcelona) and F. J. Sancho. Physica 28: 553-60(June 1962).

The conditions are studied that make the quantum mechanical adiabatic theorem valid to m-th order, and the degree of approximate validity of these conditions when the time-dependent Hamiltonian varies at a slow though finite rate. (auth)

26449 ON THE STATIC AND SPHERICALLY SYMMETRIC SOLUTIONS OF THE YANG-MILLS FIELD. Mineo Ikeda (Hiroshima Univ.) and Yoshihiko Miyachi. Progr. Theoret. Phys. (Kyoto), 27: 474-82(Mar. 1962). (In English)

The b field equations proposed by Yang and Mills are investigated from a classical point of view, and the general solution is obtained under the condition of the static and spherically symmetric field. The solution is reducible to the "canonical form" by the isotopic gauge transformation. It is likely that the mass of the b quantum is zero in spite of the nonlinearity of the field equations. (auth)

26450 THE MASS SPECTRAL CONDITION AND ANALYTIC PROPERTIES OF THE VERTEX FUNCTION. Gaku Konisi (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 27: 682-92(Apr. 1962). (In English)

In the frame of the conventional axiomatic theory of quantized fields, the vertex function is analytic in a domain bounded by an analytic hypersurface and the three static cuts, provided the three lower limits on the mass spectrum are equal. Giving priority to the spectral condition, information from the local commutativity is less utilized than in G. Källén and A. Wightman's work (Kgl. Dan. Mat.-fys. Skrifter, 1: No. 6 (1958)). The union of the new domain and that of Källén-Wightman is larger than each of them alone. (auth)

26451 INTRODUCTION OF TRUE VARIABLES AND CONSISTENCY OF HAMILTONIAN FORMALISM. Toshiei Kimura (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 27: 747-71(Apr. 1962). (In English)

In the presence of constraints, true variables in the classical theory of non-linear field are defined in a consistent way, internally and externally. When the constraints are of the second class, they are formed from the original variables by adding a linear combination of the constraints such that they have vanishing Poisson brackets with the constraints. If there are the first-class constraints, these are first converted into the second class using auxiliary conditions fixing gauges. The true variables for the Yang-Mills field are formed. When the first class constraints exist, an image of the particle is always accompanied by its potential field; true variables take this into account. The internal and external consistencies of canonical formalism for the gravitational field employed by Arnowitt-Deser-Misner and Dirac are discussed, and the nonvanishing Hamiltonian of the gravitational field is obtained unambiguously. Burton-Touschek's question about the commutation relation derived from Schwinger's dynamical principle is discussed from the standpoint of the procedure, and a method of deriving the correct commutation relation from the Feynman amplitude is given. (auth)

26452 APPLICATION OF THE PAIR MODEL TO THE NUCLEAR PHYSICAL FIVE-BODY PROBLEM. K. Dietrich (Universität, Frankfurt am Main). Z. Physik, 167: 563-83 (1962). (In German)

The nuclear five-body problem is treated as a stationary state on the basis of the independent pair model. Square well potentials with hard core, Serber exchange character, and averaged-over spin dependence are used so that the two-

particle equations (Bethe-Goldstone-equations) can be solved analytically. The calculated binding energy (−25.98 Mev) is quite close to the weighted mean value of the measured $j = 3/2$ and $j = 1/2$ resonance of nucleon-α scattering (−24 Mev). The r.m.s. radius of the α core is about 35% greater than in helium-4 which shows a moderately strong polarization of the α core by the presence of the p-nucleon. This value is also very close to the radius of the lithium-6 α core obtained by fitting the experimental charge distribution. (auth)

26453 THE THEORY OF FUNDAMENTAL PROCESSES. A Lecture Note Volume. R. P. Feynman and H. T. Yura. Frontiers in Physics. A Lecture Note and Reprint Series. New York, W. A. Benjamin, Inc., 1961. 82p.

Notes were given from a series of lectures in which were discussed all physical topics for which the theory was rather fully developed. Attention was given to general quantum mechanics, spin and statistics, rotations and angular momentum relativity, electromagnetic and Fermi couplings, parity failure, pion-nucleon coupling, strange particles and their decay, strong coupling schemes, universal coupling schemes, density of final states, the propagator for scalar particles, the propagator in configuration space, spin-$1/2$ and -1 particles, virtual and real photons, extensions of finite mass, the 4-component spinor, the Compton effect, direct pair production by muons, higher-order processes, self-energy of the electron, quantum electrodynamics, beta decay, and meson theory. (T.F.H.)

REACTOR TECHNOLOGY

General and Miscellaneous

26454 (AEEW-R-156) A GENERAL DIGITAL COMPUTER PROCEDURE FOR SYNTHESIZING LINEAR AUTOMATIC CONTROL SYSTEMS. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 31, 1961. 31p.

The fundamental concepts required for synthesizing a linear automatic control system are considered. A generalized procedure for synthesizing automatic control systems is demonstrated. This procedure was programmed for the Ferranti Mercury and the IBM 7090 computers. Details of the programs are given. The procedure uses the linearized set of equations which describe the plant to be controlled as the starting point. Subsequent computations determine the transfer functions between any desired variables. The programs also compute the root and phase loci for any linear (and some nonlinear) configurations in the comples plane, the open loop and closed loop frequency responses of a system, the residues of a function of the complex variable "s", and the time response corresponding to these residues. With these general programs available the design of "one point" automatic control systems becomes a routine scientific procedure. Also dynamic assessments of plant may be carried out. Certain classes of multipoint automatic control problems may also be solved with these procedures. Autonomous systems, invariant systems, and orthogonal systems may also be studied. (auth)

26455 (ANL-6573) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MAY 1962. (Argonne National Lab., Ill.). June 15, 1962. Contract W-31-109-eng-38. 59p.

Research progress is reported on water-cooled reactors, liquid-metal-cooled reactors, general reactor technology, plutonium recycle, advanced systems research and development, and nuclear safety. (M.C.G.)

26456 (APAE-MEMO-279) NUCLEAR ANALYSIS OF VARIOUS SPERT-III CRITICAL EXPERIMENTS. S. Paluszkiewicz (Alco Products, Inc., Schenectady, N. Y.). Apr. 27, 1961. Contract AT(30-3)-326. 36p.

The calculation models employed in the nuclear analysis of the SM-2 were applied to various critical experiments performed upon the SPERT-III core. The purpose of this analysis was to ascertain the accuracy of the models employed in predicting the reactivity of APPR-type cores, both at room temperature and under operating conditions. Results indicated that the calculated reactivities underestimated the experimental values for SPERT-III by approximately 2 to 4% $\Delta\rho$. Efforts to improve the models to reduce this discrepancy are being investigated. (auth)

26457 (APEX-729) P122 C CONTROL ACTUATOR AND LINKAGE SUMMARY REPORT. R. T. Hardin (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 12, 1961. Contracts AF33(600)-38062 and AT(11-1)-171. 8p.

Work done in the P122 reactor control actuator area is summarized. Actuators were required to radially position the absorber blades in the core of the reactor. The P122C1 was a subsonic power plant and temperatures were low enough to permit the use of hydraulics in the actuator area. The program was reoriented and the power plant designated P122C3 which was a supersonic version of the folded flow power plant. The ambient temperature at maximum power was high enough to require pneumatic actuation of the control blades. The program was reoriented after two design iterations of the subsonic power plant. A test model of the actuating equipment and the entire linkage assembly was on hand and completed when the program was cancelled. The linkage was being redesigned for the supersonic application and special bearings were ordered for fabrication into the lower temperature rig. The actual mechanical concepts of the pneumatic actuator were under study when the program was cancelled. (auth)

26458 (BAW-183) PRELIMINARY HAZARDS SUMMARY REPORT, BABCOCK & WILCOX TEST REACTOR. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). July 1962. Includes Attachments I, II, and III. 219p.

A preliminary hazards report is presented for the Babcock and Wilcox Test Reactor including a description of the Nuclear Development Center, the characteristics of the proposed site, and an evaluation of the potential hazards associated with operating the test reactor in this location. Site, facility, auxiliary systems, experimental capability, organization and procedures, and accident analysis are discussed. (M.C.G.)

26459 (BNL-5826) THERMØS. A THERMALIZATION TRANSPORT THEORY CODE FOR REACTOR LATTICE CALCULATIONS. Henry C. Honeck (Brookhaven National Lab., Upton, N. Y.). Sept. 1961. Contract [AT-30-2-GEN-16]. 77p.

A description of the THERMØS code written in Fortran for the IBM 704/709/7090 is presented. The code computes the scalar thermal neutron spectrum as a function of position in a lattice by solving the integral transport equation with isotropic scattering. One-dimensional slab or cylindrical geometry can be used. (auth)

26460 (CEA-2158) MESURES PHYSIQUES SUR LES REACTEURS DE MARCOULE. (Physical Measurements in Marcoule Reactors). A. Teste du Bailler (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 37p.

During commissioning and subsequent years of operation, various experiments were made to check design data, improve operating conditions, and test theroretical models for kinetic studies. A brief description of the measurements is given. (auth)

26461 (CRRP-1072) LATTICE MEASUREMENTS WITH 7-ELEMENT UO_2 CLUSTERS IN ZED-2. PART I: BUCKLINGS OVER A RANGE OF SPACINGS WITH THREE COOLANTS. G. A. Beer and D. W. Hone (Atomic Energy of Canada Ltd., Chalk River, Ont.). Jan. 1962. 99p. (AECL-1505)

Buckling measurements were made in ZED-2 in a series of hexagonal lattices of 55 7-element UO_2 clusters with spacings from 18 cm to 36 cm. Three materials in the cluster coolant region were investigated: D_2O of moderator purity; helium, to simulate a voided condition; and an organic liquid, HB-40. The experimental results were compared with values calculated using the latest Chalk River lattice recipes. Buckling measurements made previously with these 7-element UO_2 clusters in ZEEP are in agreement with the measurements made in ZED-2. A short description of the ZED-2 reactor is included. (auth)

26462 (DP-658) SAMPLING VALVE FOR REACTOR COOLANT. Leslie E. Goodwin (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 14p.

A prototype valve was developed to sample streams of coolant from a nuclear reactor. This valve samples eleven separate flow streams and connects them sequentially to a common output line to reduce the number of monitors required to locate a fuel element rupture. The switch was designed to operate up to a temperature of 340°C and a pressure of 900 psi. A preliminary test under laboratory conditions indicated that satisfactory performance under process conditions could be expected, after minor modifications. (auth)

26463 (DP-701) BUCKLINGS OF Pu–H_2O SYSTEMS. Hugh K. Clark (DuPont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1962. Contract AT(07-2)-1. 28p.

Multigroup, infinite medium calculations employing transport approximation are made for homogeneous Pu–H_2O systems. The bucklings and average cross sections obtained in these calculations are then used in two-group calculations to find the critical dimensions of bare and water-reflected systems. Justifications are presented for the theoretical approximations employed. Agreement of the calculations with experiment and with other calculations is shown to be quite good. Tables of bucklings and extrapolation distances, and graphs of critical dimensions are given for a wide range of plutonium concentrations. (auth)

26464 (EURAEC-255) EURATOM REACTOR FUEL MANAGEMENT PROGRAM. Interim Report. Quarterly Report No. 1. (Jackson and Moreland, Inc., Boston). Jan. 24, 1962. Work performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2875. 46p.

A discussion of the approach method and a summary of reference data are presented for use in conjunction with fuel management program studies. These studies are conducted to determine the effects of various fuel management programs on plant unit costs for boiling water reactors. The planned approach is to use the SENN dual cycle type boiling water reactor as a reference, and by holding the original core design limits as constant, the core power density will be varied in accordance with a series of proposed fuel management programs. Reference design data are tabulated and availability factors are discussed. (J.R.D.)

26465 (GAMD-1318) KINEMATIC AND DYNAMIC ANALYSIS OF RADIAL ARM INDEXING MECHANISM. TOP TRANSFER MACHINE. D. Nicoll and M. E. Timin (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 24, 1960. Contract AT(04-3)-314. 52p.

Results of analysis of the top transfer machine used in fuel handling are presented. Results indicate that the mechanism will satisfactorily adjust the radial position of the head within the limits set by the self-centering head. By jogging the electrical control buttons and holding the duration of contact down to $\frac{1}{10}$ sec, the machine will be positioned within 0.028 in. The horizontal speed of the pickup head, if the motor is maintained at synchronous speed, is 5.6 fps at the center position and 0.0105 fps at a position 59 in. from the center. However, the motor will not be maintained at synchronous speed near the center; and by proper choice of the inertia of the motor and gears and the applied torque to the mechanism, the maximum velocity at the center can be kept below 0.5 fps. This may entail a small flywheel on the motor. There will be no tendency of the cam and linkage to jam within reasonable values of rolling friction. A coefficient of rolling friction of 0.155 can be encountered before the machine stalls. This is unlikely as the coefficient of rolling friction is seldom as high as 0.020. Changing the slope of the cam at the starting position reduces the tendency of the mechanism to lock. A mathematical analysis of the dynamics of the radial arm indexing mechanism indicates that satisfactory performance can be obtained with a single speed, polyphase induction motor used both for drive and brake. However, the motor torque will vary under different operating conditions; this will be compensated by changing the voltage supplied to the motor. It may be necessary to add a small flywheel to the motor shaft in order to limit the initial acceleration to a safe value. The only control devices used by the operator are forward and reverse, normally open switches. (auth)

26466 (GEMP-123) PROGRAM 20-8, A PROGRAM FOR INTERPRETING PROGRAM 18-0 SOURCE AND ESCAPE PARTICLE TAPES. J. P. Yalch and J. E. MacDonald (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). July 1962. Contract AT(40-1)-2847. 58p.

Auxiliary program 20-8, GE-NMPO program 487, is a digital computer program that interprets program 18-0 source and escape particle tapes. Program 20-8 is coded for use on an IBM 7090 having 32,768 magnetic core memory locations. (auth)

26467 (HW-73100) RESEARCH AND DEVELOPMENT PROGRAMS EXECUTED FOR THE DIVISION OF REACTOR DEVELOPMENT. Quarterly Progress Report, October, November, December 1961. S. Goldsmith, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1, 1962. Contract AT(45-1)-1350. 227p.

Research and development on 17 programs are reported. These programs include studies on basic properties of Pu and U ceramic materials, Pu and U fuel fabrication methods, physics, chemical processing of reactor fuels and radioactive waste, materials development, radiation effects on materials, fuel cycle analysis and advanced concepts, instrumentation, and nondestructive testing techniques. (J.R.D.)

26468 (IDO-16777) A METHOD OF ESTIMATING THE KINETIC EFFECTS OF SCRAM RODS. K. V. Moore and S. R. Gossmann (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 18, 1962. Contract AT (10-1)-205. 6p.

An algebraic equation was extrapolated from the space independent kinetics equations to describe reactor power as a function of time during a power reduction. This equation, $n/n_0 = 1/1 - [\rho(t)/\beta]$, necessitates an approximate knowledge of the reactivity-time function causing the power reduction. As proof of this method a comparison was made to an ETR scram. The calculated power was within 3% of the actual measured power which is sufficient for safety purposes. Most high power reactors have several modes of power reduction, which must, for safety reasons, meet certain minimum power-time specifications. The equation developed in this report can be used to verify that the actual scram transients are within the minimum specifications. (auth)

26469 (JEN-89-DF/I-28) ESTUDIO DE ALGUNOS ASPECTOS FISICOS PREVIOS AL DISEÑO DE UNA EXPERIENCIA EXPONENCIAL. (Study of Some Physical Aspects Previous to Design of an Exponential Experiment). Rafael Caro and Jose Luis de Francisco (Spain. Junta de Energia Nuclear, Madrid). 1961. 28p.

The theoretical study of some physical aspects previous to the design of an exponential facility is presented. They are: fast and slow flux distribution in the multiplicative medium and in the thermal column, slowing down in the

thermal column, geometrical distribution and minimum needed intensity of sources, influence of the sources access channels, and perturbations produced by possible variations in its position and intensity. (auth)

26470 (KAPL-2000-18) REACTOR TECHNOLOGY REPORT NO. 21 — ENGINEERING. (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1962. Contract W-31-109-eng-52. 59p.

Developments in reactor technology in the field of engineering are discussed. A method is given for prediction of the water entrainment removal efficiency of screens. Equations were derived for pipe and rectangular channel isothermal friction factors. Four computer programs are described: VEP, a vibration eignevalue program; Stable-3 for hydraulic flow stability analysis; TTD for calculating two-dimensional steady-state temperature distributions; and SOR-II for stress analysis of shells of revolution. (M.C.G.)

26471 (NAA-SR-Memo-6938) TRANSIENT AND STEADY-STATE TEMPERATURES IN A ONE-BARREL CASK DURING LOSS OF FLOW OF HELIUM. W. A. Schumann (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 9, 1961. Contract [AT(11-1)-Gen-8]. 26p.

When a spent or half spent fuel element is removed from the reactor a few hours after shutdown and a loss of coolant flow occurs while it is in the fuel-handling cask, the following sequence of events may take place. As soon as there is a loss of coolant flow, in this case helium, the element will experience a temperature transient depending on the heat generation rate in the fuel and the heat transfer mechanism by means of which this heat is dissipated. If the heat generation rate is large, the temperature of the fuel cladding will soon reach the melting point. The fuel slugs will then drop down in the enclosure tube, filling it, and also onto the bottom gate valve. Again, depending on the heat generation rate and the means of heat transfer, the wall of the enclosure tube and/or the gate valve may melt down. For the fuel itself to melt, requires a very high heat generation rate and before this will happen the enclosure tube and bottom gate valve would have melted. The reference case which was investigated, was a fuel element in a one-barrel fuel handling cask when the element is removed three hours after shutdown. The sequence of events is given. (auth)

26472 (TID-7622) NUCLEAR REACTOR CHEMISTRY. SECOND CONFERENCE, GATLINBURG, TENNESSEE, OCTOBER 10-12, 1961. (Oak Ridge National Lab., Tenn.). 328p.

Thirty-one papers were presented at the 1961 Conference on Nuclear Reactor Chemistry on the following topics: reactor-core and coolant materials, behavior of fission products in reactor materials, and the effects of radiation on reactor materials. Twenty-three of the papers are given in full and abstracts of the remainder are included with journal or other publication references. Separate abstracts were prepared for the 23 papers. (M.C.G.)

26473 (TID-7622(p.1-23)) CARBON TRANSPORT PROBLEMS IN A HIGH TEMPERATURE GAS COOLED GRAPHITE REACTOR. P. J. Bourke and W. H. Denton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). (AERE-R-3916)

Carbon transport problems in a high-temperature reactor circuit caused by a continuous inleakage of steam were reviewed. It was concluded that the extent of carbon removal and deposition depend on the kinetics and the reversibility of the chemical reactions with graphite and on metal surfaces. Carbon removal rates for the graphite core for temperatures up to at least 1000°C were found to depend on the chemical and physical properties of the graphite and to a much lesser extent on transfer in the coolant gas stream. Chemical compatibility, the engineering problem, transfer and reaction kinetics, and reaction and diffusion kinetics in a porous solid are discussed. (M.C.G.)

26474 (TID-7622(p.24-34)) EVOLUTION OF GAS FROM HIGH PURITY GRAPHITES. L. G. Overholser and J. P. Blakely (Oak Ridge National Lab., Tenn.).

Data obtained from the degassing studies of 12 high purity graphites are presented. Two systems were used to heat the graphite in vacuo, one utilized a tube furnace for temperatures to 1000°C, the other an induction heater for temperatures to 1800°C. The loss in weight experienced by the various graphites was 0.01 to 0.02% when degassed to a maximum temperature of 1800°C. A weight loss of approximately 0.005% was observed for the graphites on degassing to a maximum temperature of 1000°C. This weight loss was greater than the weight of gas removed (in many cases by a factor of 2). The volume and composition of the gas as functions of time and temperature were studied. (M.C.G.)

26475 (TID-7622(p.35-56)) IMPURITIES IN A LIQUID METAL COOLANT AND THEIR EFFECT ON THE FUEL ELEMENT CANNING MATERIALS NIOBIUM AND VANADIUM. V. M. Sinclair, R. A. H. Pool, and A. E. Ross (United Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland).

The properties of hydrogen, nitrogen, oxygen, and carbon in liquid metal coolant and the effects of these non-metallic impurities on the niobium and vanadium fuel can metals under operating conditions of the Dounreay Fast Reactor were studied. The presence of hydrogen led to embrittlement of the fuel cans. It was found that this hydrogen can be effectively controlled by cold-trapping the primary coolant near 100°C. Above 400°C vanadium was found to take up nitrogen and niobium took up nitrogen above 550°C. Control of oxygen levels in the primary coolant was achieved by operation of a cold trap and by hot trap containing zirconium. Carbon attack on niobium and vanadium led to formation of carbides on the surfaces of the specimens. (M.C.G.)

26476 (TID-7622(p.57-73)) PREPARATION OF CERAMIC-COATED NUCLEAR-FUEL PARTICLES. J. M. Blocher, Jr., M. F. Browning, A. C. Secrest, V. M. Secrest, and J. H. Oxley (Battelle Memorial Inst., Columbus, Ohio).

Work on fuel particle coatings of Al_2O_3, BeO, MgO, and pyrolytic carbon is reported. Chemical vapor deposition and fluidized-bed methods of particle coating are described. The promise of coated nuclear fuel particles and the practicability of their fabrication are discussed. (M.C.G.)

26477 (TID-7622(p.74-85)) INVESTIGATIONS OF NUCLEAR FUEL-BEARING GLASSES. Paul A. Lockwood (Owens-Corning Fiberglas Corp. Technical Center, Granville, Ohio).

Research on nuclear fuel-bearing glasses is reviewed. About 400 glass compositions containing oxides of uranium, thorium, and plutonium, or combinations of these oxides were investigated. Urania glasses containing 50% by weight U_3O_8 were produced in standard forming equipment and urania glasses with as high as 65% by weight ThO_2 and U_3O_8 were developed and successfully fiberized. Several urania glasses were produced with properties similar to commercial fibrous glass for utilization in a wide variety

of forms and conditions and special high-temperature glasses are available for studies at 1600°F and above. (M.C.G.)

26478 (TID-7622(p.86-97)) DEVELOPMENT OF PLUTONIUM BEARING GLASS FOR A REACTOR FUEL. P. A. Tucker, L. V. Jones, and L. J. Wittenberg (Mound Lab., Miamisburg, Ohio).

It was found that plutonium oxide can be dissolved in silicate glasses to form a homogeneous material which greatly reduces the toxicity problem associated with handling plutonium. The fibers drawn from these glasses have high tensile strengths and good chemical durability. (M.C.G.)

26479 (TID-7622(p.98-107)) DEVELOPMENT OF PROTECTIVE METAL COATINGS FOR UO_2 AND U PARTICLES. L. P. Pepkowitz, B. L. Vondra, and F. Shipko (Nuclear Materials and Equipment Corp., Apollo, Penna.).

The development of a strong, uniform, corrosion resistant, impervious metallic coating for individual spherical particles of UO_2 or uranium metal is discussed. A horizontal-type reactor for vapor phase coating is described. Coating procedures for various types of materials are outlined. Problems in coating uranium metal are discussed. (M.C.G.)

26480 (TID-7622(p.109-20)) PREPARATION AND PROPERTIES OF FLUOROCARBONS OF INTEREST IN REACTOR TECHNOLOGY. F. W. Bloch, D. R. MacKenzie, and R. H. Wiswall, Jr. (Brookhaven National Lab., Upton, N. Y.). (BNL-5770)

A survey of the radiation chemistry of fluorocarbons was begun. The fluorocarbon analogs of those aromatic compounds which have proved to be among the most stable of all organic compounds, the polyphenyls and naphthalene. Preparation and purification of materials are described. Electron, gamma, and reactor irradiations were carried out on several unpurified materials. G-values were determined for total gas yield and polymer formation. Only a few of the products other than gases were identified in the preliminary analyses. Overall stabilities of the fluorocarbons were lower than those of hydrocarbons. Gas yields from alicyclic fluorocarbons were much higher than for aromatics, but polymer yields were of the same order or lower. (M.C.G.)

26481 (TID-7622(p.122-7)) PREPARATION OF HIGH PURITY BERYLLIUM OXIDE. R. E. Moore, J. H. Shaffer and H. F. McDuffie (Oak Ridge National Lab., Tenn.).

A solvent extraction process for obtaining high-purity BeO is described. The process consists of extracting a solution of beryllium acetylacetonate in CCl_4 with an acid solution containing EDTA. Beryllium is largely retained in the organic phase while most metallic impurities are complexed with EDTA in the aqueous phase. The beryllium is subsequently back-extracted into nitric acid and precipitated as hydroxide with ammonium hydroxide. BeO is prepared by calcining the pure hydroxide at 600 to 1000°C. (M.C.G.)

26482 (TID-7622(p.128-36)) SURFACE TENSION OF FUSED SALTS: AN EMPIRICAL CORRELATION. Richard B. Ellis and William S. Wilcox (Southern Research Inst., Birmingham, Ala.).

Statistical mechanical approaches were adapted to derive equations for the surface tension of fused salts. For purposes of correlation of surface structure and energy with surface tension, a function consisting of the lattice energy the polarization energy $X = E_L - E_a$ was chosen. In order to put these factors into terms of energy per unit area, a model structure of the surface was developed based on that of the (100) plane of the NaCl crystal. The correlation function worked fairly well with the alkali halides on an empirical basis. (M.C.G.)

26483 (TID-7622(p.139-48)) URANIUM OXIDE PRESSURE-TEMPERATURE-COMPOSITION RELATIONSHIPS FROM 1000 TO 2000°K. Carl A. Alexander (Battelle Memorial Inst., Columbus, Ohio) and Thomas S. Shevlin (Ohio State Univ., Columbus).

Data for construction of a U–O pressure-temperature-composition phase diagram to temperatures of approximately 1400°K were collected from various investigators. Consistency with fundamental thermodynamic data was a requirement in its construction. (M.C.G.)

26484 (TID-7622(p.149-59)) RELEASE OF FISSION PRODUCTS FROM REACTOR-GRADE UO_2 BY DIFFUSION, OXIDATION, AND MELTING. G. W. Parker, G. E. Creek, and W. J. Martin (Oak Ridge National Lab., Tenn.).

Release of fission products from reactor-grade UO_2 was studied as a function of burnup or fission density in the fuel. Release by oxidation, diffusion into helium, and melting were compared. (M.C.G.)

26485 (TID-7622(p.160-70)) A THEORY FOR CALCULATING THE RELEASE OF FISSION GASES FROM DEFECTIVE SHEATHED CERAMIC FUEL ELEMENTS. H. S. Dreyer (Aerojet-General Nucleonics, San Ramon, Calif.).

A method was proposed for calculating the release of fission gases from defective sheathed ceramic fuel elements at steady state based on the release of the gases by recoil followed by subsequent diffusion of the molecules down the annulus to the defect. Equations are given. (M.C.G.)

26486 (TID-7622(p.171-92)) USE OF THE KING FURNACE IN FISSION PRODUCT RETENTION STUDIES OF GRAPHITE REACTOR FUELS. E. E. Anderson, P. E. Gethard, and L. R. Zumwalt (General Atomic Div. General Dynamics Corp., San Diego, Calif.).

Fission product release at high temperatures was studied by the use of graphite tube resistance furnaces. Three versions of the furnace were developed and utilized to satisfy specific requirements. The furnace components are described including the heating element, supporting electrodes and baseplate, radiation shielding, power supply, containment, gas pressure system, vacuum system, and cooling system. Results on fission product release are presented in graph form. The data indicated that the behavior is not explained by simple diffusion. (M.C.G.)

26487 (TID-7622(p.193-206)) STUDIES OF FISSION GAS RELEASE FROM IN-PILE TESTS. I. RECOIL LOSS FROM CERAMIC FUEL ELEMENTS. E. A. Aitken, P. K. Conn, E. S. Collins, and R. E. Honnell (General Electric Co. Flight Propulsion Lab. Dept., Evendale, Ohio).

The measured recoil release fraction for several fission products from a dense thin slab of BeO containing chemically stabilized UO_2 was in excellent agreement with the recoil release predicted from a theoretical calculation made for the same geometry. The measured release indicated that recoil was the dominant release mechanism. The data appeared to be independent of time to 236 hr. The measured release increased with increasing temperature above 1400°C. Use of a stabilizing additive with UO_2 in the fuel phase greatly improved the fission product retention of the BeO dispersed oxide type samples over that of the BeO–UO_2 samples without the stabilizing additive. (M.C.G.)

26488 (TID-7622(p.207-15)) RELEASE OF FISSION PRODUCTS ON THE IN-PILE MELTING OF REACTOR FUELS. R. P. Shields, C. E. Miller, Jr., R. A. Lorenz, and W. E. Browning, Jr. (Oak Ridge National Lab., Tenn.).

Studies are being made to determine the fission product release characteristics of various fuels under conditions which simulate as closely as possible those which may exist at the time of a reactor incident. Fission product release when fuel materials are melted was investigated. The only experiment completed had a 3% enriched UO_2 specimen. Examination of the test specimen indicated that a large part of the UO_2 had undergone a change of state. (M.C.G.)

26489 (TID-7622(p.218-35)) THE REMOVAL OF RADIOACTIVE KRYPTON AND XENON FROM A FLOWING HELIUM STREAM BY FIXED-BED ADSORPTION. R. D. Burnette, W. W. Graham, III, and D. C. Morse (General Atomic Div. General Dynamics Corp., San Diego, Calif.). (GA-2395)

Fixed-bed adsorption was used to remove krypton and xenon from helium streams. The studies were initiated in order to provide the necessary information for the design of a fission-product trapping system for the HTGR. General relationships were derived describing the behavior of radioactive gases in an adsorber. The choice of adsorbents to be tested was limited to various grades of activated charcoal, since previous work indicated that charcoal was superior to other adsorbents in this application. The adsorption coefficients for both krypton and xenon were plotted against inverse temperature. (M.C.G.)

26490 (TID-7622(p.236-42)) FISSION PRODUCT LEVELS IN THE SM-1 COOLANT. C. A. Bergmann and J. F. Cox (Alco Products, Inc., Schenectady, N. Y.).

Data on fission product activities found in the SM-1 coolant during nearly 4 years of operation are presented. The data indicated that Core I definitely had defects in the cladding. However, the level of fission product activity was not sufficient to cause any major operational or health physics problems. (M.C.G.)

26491 (TID-7622(p.245-53)) XENON-133 DIFFUSION IN ALUMINA. R. H. Barnes, T. S. Elleman, and D. N. Sunderman (Battelle Memorial Inst., Columbus, Ohio).

Diffusion coefficients were determined for Xe^{133} in single-crystal α-alumina at temperatures ranging from 700 to 1550°C. Small spheres of α-alumina were dispersed in UO_2 powder and irradiated at low temperatures. These spheres were then separated from the powder and heated at a constant rate. Xe^{133} released from the alumina was measured as a function of time. In general Xe^{133} diffusion was about two orders of magnitude more rapid than oxygen self-diffusion in α-alumina. (M.C.G.)

26492 (TID-7622(p.254-62)) MEASUREMENT OF HELIUM GENERATION AND RELEASE IN IRRADIATED BeO. Frank F. Felber, Jr. (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown).

The apparatus, techniques, and results of measurements of the fractional helium release from pressed and sintered BeO pellets by total sample dissolution in a closed system are described. A bundle of 19 specimens of BeO was irradiated. Afterward the specimens were vented, then dissolved in a closed system. Results are presented in tables. They show that, for temperatures up to 1600°F and irradiation times of the order of 700 hr, it is necessary to allow for about 1 to 2% helium release from BeO of greater than 92% purity and 93% density. The lack of a definite correlation between release and density or purity indicated that somewhat poorer grades of BeO might also have a 98% helium retention factor. (M.C.G.)

26493 (TID-7622(p.263-81)) IRRADIATION EXPERIMENTS WITH AQUEOUS SUSPENSIONS OF PuO_2 AND ThO_2-UO_2. H. S. G. Slooten (Keuring van Electrotechnische Materialen, N. V., Arnhem, Netherlands), R. G. Sowden, B. R. Harder, and A. E. Truswell (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Progress made in defining the factors which control radioinduced fragmentation of particles in aqueous suspensions of PuO_2 and ThO_2–UO_2 systems. Pile irradiations were carried out in the belt-stringer of the BEPO reactor. The results of the irradiation experiments are summarized in tables and graphs. At high levels of breakup the appearance of the supernate after centrifugation of the irradiated slurry at 1000 G was that of a clear solution, colored bright green in the case of the PuO_2 experiments and yellow-brown in the case of the ThO_2–UO_2 experiments. When irradiation was carried out under flocculating conditions, the degree of fragmentation was markedly reduced. The fragmentation per fission at the early stages of breakup was roughly proportional to the surface area of the unirradiated solid. (M.C.G.)

26494 (TID-7622(p.282-99)) IRRADIATION EFFECTS ON THORIA-URANIA SLURRIES. E. L. Compere, A. J. Shor, L. F. Woo, and H. C. Savage (Oak Ridge National Lab., Tenn.).

Radiation effects on aqueous slurries of ThO_2–UO_2 powders are described. A number of slurry preparations were exposed to reactor irradiation at elevated temperatures in autoclaves and in an in-pile slurry loop. Fissioning in the particles resulted in substantial reductions in crystallite size and increases in surface area. In a pumped loop experiment, particle size degradation was also noted. A substantial number of very small diameter internal voids were revealed in the irradiated material. (M.C.G.)

26495 (TID-7622(p.310-15)) FORMATION AND DISTRIBUTION OF DISSOLVED GASES AND HYDROGEN PEROXIDE IN THE WATER OF A SWIMMING-POOL REACTOR (TRITON). J. Chenouard, J. Rozenberg, L. Dolle, and G. Dirian (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay).

Translated from the original French by A. L. Monks (Oak Ridge National Lab.), p.300-309.

Studies were made of the concentration of the radiolysis gas and hydrogen peroxide dissolved in the water of the Triton reactor. Measurements were taken before startup, during startup, and during steady-state operation. The radiolysis rate was determined by studying the variation with time of the amounts of hydrogen peroxide and of gas in solution in the water leaving the core. Concentrations of hydrogen, oxygen, nitrogen, and hydrogen peroxide were determined. Hydrogen was always present in the pool water in considerable amounts even after a prolonged shutdown of the reactor and with the water circulating. This confirmed the extreme slowness of the degasification. It was indicated that there is no liberation of radiolytic gas under normal operating conditions. Overall radiolysis was practically zero because of the equilibrium due to conditions of circulation and geometry which permitted recombination of the radiolysis products in the swimming pool. (M.C.G.)

26496 (TID-8200(6th Rev.)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1962. (Division of Reactor Development, AEC). 25p.

Information concerning facilities built, being built, or

planned in the U. S. as of December 31, 1961, which are capable of sustaining a nuclear chain reaction, is given. Information is presented in 5 parts, each of which is categorized by primary function or purpose. The categories are: civilian reactors (domestic), military reactors, production reactors, reactors for export, and critical facilities. Dismantled reactors are included because of their significant contributions to reactor technology. (P.C.H.)

26497 (TID-16138) GAS COOLED REACTOR VESSEL STUDY. George E. St. Cin and T. M. Pierson (Combustion Engineering, Inc. Nuclear Components Engineering Dept., Chattanooga). 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 2167. 84p. (CE-1076)

Results of a study on the feasibility of constructing large gas cooled reactor vessels are presented. Included are conceptual drawings of spherical and cylindrical reactor vessels designed to satisfy specified parameters; investigation of the feasibility of low alloy, high yield strength steel for vessel construction; evaluation of limitations on fabrication, shipping, and site erection of the vessel; and analysis of the designs to determine areas requiring additional study. (auth)

26498 (AEC-tr-5212) CALCULATION OF THE FISSION PRODUCT ACTIVITY IN THE LOOP AND COMPARISON WITH SOME EXPERIMENTAL RESULTS FROM MOL. (Brown Boveri/Krupp Reaktorrbau GmbH, Mannheim, Germany). Translated for Oak Ridge National Lab., Tenn. May 23, 1962. 18p.

Investigations were conducted on the behavior of fission products in the fuel elements and in the loop, respectively, in Mol, both for the insert pellets and for the complete fuel element. The determinations were limited to the fission products which are most important with respect to surface contamination and to the radiation danger in the case of a maximum accident. These measurements were in agreement with known concepts about adsorption and other storage effects in graphite and uranium carbide. Consequently, the concepts developed were applied to the isotopes which were not measured individually. (auth)

26499 ELECTRIC DRIVES FOR THE REGULATING RODS IN NUCLEAR REACTORS. W. Knuth. Elektrie, 14: 347-52(Oct. 1961). (In German)

The possible kinds of drive for control rods in reactors were surveyed including servomotors, linear motors, and lifting magnets. The construction of each is described. (auth)

26500 THE INDIVIDUAL SOURCE-SINK METHOD FOR SYSTEMS OF FINITE HEIGHT. C. Sheffield (English Electric Co. Ltd., Whetstone, Leicester, Eng.). J. Nuclear Energy, Pts. A & B. Reactor Sci. and Technol., 16: 245-59 (May 1962).

The method of individual source-sinks was applied to a reactor of finite height. Diffusion theory moderator flux distributions were obtained at any height in the reactor, without assuming a cylindrical cell boundary and with fuel elements whose properties may vary up the reactor. The effects of temperature variations in the moderator are discussed, but axial streaming of neutrons was not taken into account. As an example of the scope of the method, three-dimensional flux fine structure was obtained in a system containing a control rod part-way inserted. (auth)

26501 CORE KINETICS OF FISSION REACTORS. L. G. Kemeny (Univ. of London). Nature, 195: 270-1(July 21, 1962).

The autocorrelation function of reactivity fluctuations in a reactor at low power was computed; the experimental results support the simplified kinetic theory. The departure of the function from the exponential indicates higher frequency components in the core fluctuation. Experiments to be made for studying core kinetic fluctuations with cross-correlation are described. (D.L.C.)

26502 CALORIMETRIC MEASUREMENT OF NUCLEAR HEATING IN A REACTOR. C. D. Bopp and R. L. Towns (Oak Ridge National Lab., Tenn.). Nuclear Sci. and Eng., 13: 245-9(July 1962).

A calorimeter, for measuring nuclear heating in reactors, of simple construction and high sensitivity is described. Calorimeters of this design are used to measure the nuclear heating in magnesium and bismuth in an experimental facility of the ORNL Graphite Reactor. Gamma radiation gives the most important contribution to nuclear heating for these two elements. Self-shielding is estimated, and the consistency between the measurements for bismuth and magnesium is demonstrated. (auth)

26503 PHYSICS OF FAST AND INTERMEDIATE REACTORS. VOL. I. Proceedings of the Seminar on the Physics of Fast and Intermediate Reactors, held in Vienna, 3-11 August 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Mar. 1962. 487p. (STI/PUB/49(Vol. I)). $9.00(IAEA).

Characteristics and capabilities of fast and intermediate power reactors are discussed. Eighty-four papers are presented in three volumes. Neutron physics and integral experiments are discussed in Volume I. Thirty-one papers are abstracted separately and five papers were previously abstracted for Nuclear Science Abstracts. (L.N.N.)

26504 REQUIREMENTS FOR FAST-NEUTRON DATA AND THE FAST-NEUTRON CROSS-SECTION MEASURING PROGRAMME IN THE UNITED KINGDOM. A. T. G. Ferguson (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and R. Batchelor. p.21-6 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The requirements for fast-neutron data arising from the fast-reactor and shielding programs are surveyed, and methods of assessment of accuracy and energy range are discussed. The most urgent need is for fission cross sections below 150 kev, accurate knowledge of $\bar{\nu}$ as a function of neutron energy, and inelastic neutron scattering cross sections for neutrons to 5 Mev. The facilities available for making these measurements are described. Experimental programs to satisfy these requirements are considered. (auth)

26505 A CRITICAL SUMMARY OF MICROSCOPIC FAST-NEUTRON INTERACTIONS WITH REACTOR STRUCTURAL, FISSILE AND FERTILE MATERIALS. A. B. Smith (Argonne National Lab., Ill.). p.29-54 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (TID-13546). (In English)

Knowledge of fast-neutron-induced reactions utilized in the nuclear design of reactor systems is reviewed. Emphasis is placed upon microscopic experimental methods, and precisions. Fast-neutron scattering is considered, including the results of experimental determinations of scattering from oxygen, iron, zirconium, niobium, tungsten, thorium, and uranium. Representative results of experimental studies of fast-neutron capture and fast-neutron-induced fission are given. The measurements provide results of applied usefulness and are examples of the application of advanced experimental nuclear techniques. Areas of limited, conflicting, or non-existent experimental information are outlined. A prognosis of future knowledge of

fast-neutron reactions is made, emphasizing the fulfillment of reactor requirements for basic nuclear data. (auth)

26506 MEASURING CROSS-SECTIONS IN FAST REACTORS. F. Cheynier, R. Joly, J. R. Leroy, A. Michaudon, and P. Ribon (Commissariat à l'Énergie Atomique, France). p.55-63 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Measurements of cross sections of significance for fast reactors were performed. The measurements on intermediate neutrons were made with a 28-Mev electron linear accelerator using the time-of-flight method, with a resolution $\Delta t/L$ of 0.01 $\mu s/m$. The results of the U^{235} fission cross-section measurements are given and analyzed. For fast neutrons, an arrangement giving fast beam pulsation was evolved and applied to measurement of total cross-sections by the time-of-flight method, and can be adapted to either of the accelerators available (300 and 600 kv.) (auth)

26507 ANGULAR DISTRIBUTIONS OF FAST NEUTRONS SCATTERED BY Al, Si, P, S, AND Zn. K. Tsukada, S. Tanaka, M. Maruyama, and Y. Tomita (Japan Atomic Energy Research Institute, Tokyo). p.75-85 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Differential scattering cross sections of Al, Si, P, S, and Zn for fast neutrons were measured at 3.4 to 4.6 Mev using the time-of-flight method. Angular distributions of the inelastically scattered neutrons are nearly isotropic. Results are discussed on the basis of the Hauser-Feshbach theory. (auth)

26508 NEUTRON INELASTIC SCATTERING BY SODIUM-23. J. H. Towle and W. B. Gilboy (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.87-93 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Measurements of neutron scattering cross sections in fast reactors for neutrons of energies up to 4 Mev is in progress at AWRE. The time-of-flight technique is used. Results are presented for Na to 2 Mev, with provisional results at 3.97 Mev. Differential cross sections were measured for the elastic and inelastic scattering of 1.5-Mev neutrons by Na^{23}. The results were corrected for multiple scattering and other effects due to the finite size of the Na^{23} metal sample, using a Monte Carlo computer program. The sum of the integrated cross-sections agree with the total cross section measured by transmission using the same apparatus. The variation of the cross section for inelastic scattering was obtained at 0.5 to 2.0 Mev by measuring the yield of 0.44-Mev γ rays at 125° to the incident neutron flux. At this angle, the γ-ray yield is proportional to the total inelastic cross section for an angular distribution of the form $1 + A P_2(\cos\theta)$ expected for this transition. The angular distribution of γ rays was $1 + 0.14 P_2$ using 1.5-Mev incident neutrons. The inelastic cross-section curve was normalized at 1.5 Mev to the value obtained by observing the neutrons. The over-all errors on the points are ±6%. (auth)

26509 NEUTRON CAPTURE CROSS-SECTIONS FOR ENERGIES ABOVE A FEW HUNDRED ELECTRON-VOLTS. J. H. Neiler (Oak Ridge National Lab., Tenn.). p.95-109 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Information on neutron radiative capture cross sections at intermediate energies is presented. The cross sections of about 50 elements were determined, relative to absorption cross section of indium, near 30 and 65 kev obtained using a pulsed positive-ion accelerator. Normalizing to these cross sections, the radiative capture cross sections of about 30 elements were measured as a function of neutron energy at 0.2 to 170 kev. Chopper and pulsed-accelerator techniques were used. Statistical model curve-fits of the latter data for heavy nuclei, in which the kev cross sections are an average over many resonances, generally agree with the average nuclear parameters obtained from low-energy total cross-section results. (auth)

26510 MEASUREMENTS OF α FOR U^{233}, U^{235} AND Pu^{239} FOR MONOENERGETIC NEUTRONS. J. C. Hopkins and B. C. Diven (Los Alamos Scientific Lab., N. Mex.). p.111-17 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (TID-12896). (In English)

The ratio of neutron capture to fission cross sections, α, was measured for U^{233}, U^{235}, and Pu^{239} at 30 to 1000 kev. A pulsed and collimated neutron beam is passed through the target at the center of a large cadmium-loaded liquid scintillator. Captures and fissions are detected by their prompt gamma rays; elastic and inelastic scattering events are ignored because of their smaller pulse heights. Fission events are identified by the neutrons that accompany the fission process. These neutrons are thermalized in the scintillating solution and provide delayed pulses which characterize a fission event. Capture events are not followed by delayed pulses from the scintillator. Corrections are applied for the fission events not followed by delayed-neutron pulses and for the effect of background counts. The capture, capture-plus-fission, and background events are recorded simultaneously. This procedure yields values of $1 + \alpha$ to an accuracy of 1 or 2%. (auth)

26511 EFFECTIVE RESONANCE ABSORPTION INTEGRALS FOR ZIRCONIUM AND NIOBIUM. E. Hellstrand, G. Lindahl, and G. Lundgren (Aktiebolaget Atomenergis, Sweden). p.119-21 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The resonance absorption integrals of zirconium and niobium were measured at the reactor R1 using the pile-oscillator technique. For niobium, measurements were also made by activation. Results of the methods agree within the limits of error. (auth)

26512 EXPERIMENTAL STUDIES OF FISSION PROPERTIES UTILIZED IN REACTOR DESIGN. D. Butler, S. Cox, J. Meadows, J. Roberts, A. Smith, and J. Whalen (Argonne National Lab., Ill.). p.125-37 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Experimental studies of fission parameters useful in reactor design are described. The periods and yields of delayed-neutron groups emitted following the neutron-induced fission of Pu^{241} are measured. Evidence for systematic isotopic dependence of delayed-neutron yields is presented. An experimental investigation of the relation between the time behavior of delayed-neutron emission and the energy of the incident neutron inducing fission is described. The cross section for the inducing of fission in Am^{243}, Pu^{242}, and Pu^{241} using neutrons at 0.030 to 1.8 Mev is measured. Emphasis is placed upon the detailed dependence of the fission cross-section on the incident-neutron energy. The absolute values of the cross-sections are given to a precision of ~25%. Results of a measurement of the Pu^{241} fission-neutron spectrum are given, including the spectral shape and average fission-neutron energy. Techniques and methods of measuring prompt-fission-neutron spectra are described. The dependence of $\bar{\nu}$ (the average number of neutrons emitted per

fission) of U^{235} on the incident neutron energy is measured at 0.1 to 1.6 Mev. $\bar{\nu}$ of U^{238} and other fissile isotopes is compared to $\bar{\nu}$ of U^{235} (thermal). The relative precision of the measurements is $\gtrsim 1.2\%$. (auth)

26513 THE NUMBER OF PROMPT NEUTRONS FROM U^{235}-FISSION OVER THE RANGE 0.04 TO 3 MeV. A. Moat, D. S. Mather, and P. Fieldhouse (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.139-48 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency. 1962. (In English)

The number, $\bar{\nu}$, of prompt neutrons from the neutron-induced fission of U^{235} was measured as a function of neutron energy at 0.04 to 3.0 Mev. The reactions Li(p,n) and T(p,n) were used, the protons being accelerated by a 6-Mv Van de Graaff. A collimated beam of neutrons from the target was incident on a fission ionization chamber, which was placed at the center of a spherical 240-l loaded liquid scintillation counter. This counter had an efficiency of about 88%; it was surrounded by a massive neutron shield. Spot measurements of $\bar{\nu}$ were made to a statistical accuracy of about 1%, and are quoted relative to the 0.04-Mev value. Fissions were induced only by neutrons of the desired energy: this was achieved by pulsing the proton beam from the Van de Graaff and applying time-of-flight selection to the neutrons from the target. (auth)

26514 NUMBERS OF PROMPT NEUTRONS PER FISSION FOR U^{233}, U^{235}, Pu^{239} AND Cf^{252}. B. C. Diven and J. C. Hopkins (Los Alamos Scientific Lab., N. Mex.). p.149-54 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

An absolute measurement of $\bar{\nu}$, the average number of prompt neutrons emitted per fission, is made for the spontaneous fission of Cf^{252}. The relative values of $\bar{\nu}$ are measured for neutron-induced fission of U^{233}, U^{235}, and Pu^{239} and are compared with the spontaneous fission $\bar{\nu}$ of Cf^{252}. Neutrons at thermal energies to 15 Mev are used. Emphasis is placed on studying the dependence of $\bar{\nu}$ on the incident neutron energy. A fission counter containing the appropriate isotope is placed in the center of a large cadmium-loaded liquid scintillator. Through the fissionable isotope, a collimated beam of neutrons is passed. Fission events, identified by pulses from the fission counter, open an electronic gate between the large liquid scintillator and a scaler. Scintillator pulses due to capture in the scintillating solution of thermalized fission neutrons are counted during the gate. The fission neutrons are detected almost independently of energy and with very high efficiency. With this technique values of $\bar{\nu}$ to an accuracy of 1% are expected. (auth)

26515 AN ABSOLUTE MEASUREMENT OF $\bar{\nu}$ OF CALIFORNIUM-252. I. Asplund, H. Condé, and N. Starfelt (Research Institute of National Defence, Stockholm). p.155-62 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

An absolute determination of the average number of neutrons, $\bar{\nu}$, emitted in the spontaneous fission of Cf^{252} was made by counting the fission neutrons in a large liquid scintillator. The detection efficiency of this counter was measured as a function of neutron energy. Well-collimated neutrons were scattered into the scintillator by an anthracene crystal, which detected the corresponding recoil protons. Pulse-shape discrimination was employed to eliminate γ-ray background. The detection efficiency for Cf^{252} fission neutrons was 0.703 ± 0.007, giving 3.78 ± 0.04 for the average number of prompt neutrons emitted per Cf^{252} fission. (auth)

26516 STATISTICAL EMISSION IN NUCLEAR REACTIONS. E. Erba, U. Facchini, and E. Menichella Saetta Università, Milan and Laboratori C.I.S.E., Milan). p.165-70 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Statistical models in nuclear reactions were developed; understanding of the experimental situation regarding low- and medium-energy nuclear reactions is not settled. The interpretation is complicated by the fact that the reactions often proceed via other mechanisms. Experiments can agree with the statistical formulas, and particularly the resonance measurements for slow neutrons, the evaporation spectra from medium-energy (n,n'), (p,n) and (n,p) reactions, and the (n,p) cross sections at 14 Mev. From the experiments discussed, it is possible to obtain a consistent table of a, the parameter of the level density formula. (auth)

26517 CALCULATION OF FAST-NEUTRON REACTION CROSS-SECTIONS. P. A. Moldauer (Argonne National Lab., Ill.). p.171-7 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (TID-13526). (In English)

The radiative-capture and inelastic-scattering cross sections in reactor materials of neutrons at 1 kev to several Mev are important in the analysis and design of fast reactors. Improvements in the theoretical description of such processes and the evaluation of the necessary nuclear parameters make it possible to obtain reliable estimates of their cross sections. Examples are presented. (auth)

26518 NEUTRON FISSION PRODUCT CROSS-SECTIONS. V. Benzi and A. M. Saruis (Comitato Nazionale Energia Nucleare, Bologna). p.179-86 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Absorption cross sections for fission products were calculated at 10^3 to 10^5 ev using the statistical model. Neutron angular momenta $l = 0$ and $l = 1$ were considered. Results are compared with those obtained by P. Greebler, et al., (Nuclear Sci. and Eng. 2: 334(1957)) for the energy dependence of the cross-sections, and with those given by Walker for the unresolved resonance integrals. (auth)

26519 GROUP CROSS-SECTIONS FOR FAST REACTORS. P. F. Zweifel and G. L. Ball (Atomic Power Development Associates, Inc., Detroit). p.189-205 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Multi-group-diffusion equations are given, and the correct form of the group cross sections is discussed. The average transport cross section may be written to a certain approximation in terms of an average mean free path. The calculation is lengthy because it is not amenable to expression in terms of elemental averages; inequalities are proved which simplify the averaging procedure required. The use of the same set of group-averaged cross sections for all fast reactors is invalid if the spectra in different reactors are dissimilar and if the cross-sections vary rapidly over the group, conditions which frequently hold. An iteration procedure is described by which the correct averages are found; it is used to determine the sensitivity of reactor calculations to spectral effects. In transport calculations such as S_n, averages must be made over angle and energy. Since the flux is non-separable in angle and energy, care is necessary to avoid erroneous results. The S_n equation is studied in terms of a simple model, and a criterion is derived which may prove useful in determining the importance of angular nonseparability in reactor calculations. A consistency relation among group-diffusion coefficients, slowing-down power and absorption cross-sections is derived from

neutron-conservation arguments. A definition of group absorption cross section in terms of effective resonance integrals is not correct; it must be modified according to the type of multi-group scheme used. (auth)

26520 A PUNCHED-CARD LIBRARY OF NEUTRON CROSS-SECTIONS AND ITS USE IN THE MECHANIZED PREPARATION OF GROUP CROSS-SECTIONS FOR USE IN MONTE CARLO, CARLSON S_n AND OTHER MULTI-GROUP NEUTRONICS CALCULATIONS ON HIGH-SPEED COMPUTERS. K. Parker (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.207-30 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The AWRE punched-card library of neutron cross sections is described. Associated IBM-7090 programs which process this data to give group-averaged cross sections for use in Monte Carlo, Carlson S_n, and other multi-group neutronics calculations are discussed. The methods developed to deal with isotropic and anisotropic elastic scattering are described. These include the multi-group transport approximation and treatment of anisotropic scattering using the Legendre polynomial moments of the scattering transfer matrix. Principles of group-constant formation are considered and illustrated by describing systems of group constants suitable for fast-reactor calculations. Problems such as the empirical adjustment of group constants to reproduce integral results and the collapsing of a many-group set of constants to give a few-group set are discussed. (auth)

26521 AN ACCURATE TREATMENT OF RESONANCE SCATTERING IN LIGHT ELEMENTS IN FAST REACTORS. H. Hummel and A. Rago (Argonne National Lab., Ill.). p. 231-50 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The rapid fluctuation with energy of scattering cross sections of light- and medium-weight elements present in fast reactors is studied. An IBM-704 code, ELMOE, was prepared, which combines any desired standard cross-section set containing 10 to 20 groups available in a library of such sets containing detailed data on the energy variation of the Legendre coefficients of the scattering cross-section of resonance scatterers. A fine group fundamental mode calculation is carried out using several hundred groups, and diffusion coefficients and elastic removal cross-sections are evaluated for the resonance scatterers for the standard groups. The code was applied to mixtures of uranium, aluminum, stainless steel, and oxygen, corresponding to ZPR-III critical experiments. Effective light- and medium-element group cross-sections show a significant variation with composition, particularly below about 500 kev, where resonance structure is more pronounced. This variation in extreme cases amounts to a factor of 2 or more. (auth)

26522 INTEGRAL EXPERIMENTS ON FAST SYSTEMS OF PLUTONIUM, URANIUM AND THORIUM. J. J. McEnhill and J. W. Weale (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.253-62 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Two types of integral experiments undertaken to provide experimental checks on nuclear data and methods of calculation are described. A cylindrical assembly of material having a point source of DD or DT neutrons at its center is discussed. The neutron flux and reaction rates in the cylinder material are measured as a function of position. Results are compared with calculations. Data for natural uranium and thorium are presented. A low-power experimental reactor of simple regular geometry and approximately homogeneous composition is described. Holes can be provided as required for the insertion of counters or perturbation samples. The core composition is adjusted by the addition of a moderator to provide a neutron spectrum that tests the nuclear data in the energy region of interest. Measurements of the neutron-energy spectrum and various reaction rates and perturbation cross sections as a function of position in the reactor are made, and the results are compared with computer calculations. Results are presented for a system consisting of a core of U^{235} and graphite surrounded by a natural-uranium reflector. (auth)

26523 CRITICAL EXPERIMENTS AND NUCLEAR CALCULATIONS—LAMPRE-I. M. E. Battat (Los Alamos Scientific Lab., N. Mex.). p.263-70 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

As part of a program to develop plutonium fuels for fast-breeder reactors, the Los Alamos Scientific Laboratory has constructed and is operating a 1-Mw sodium-cooled test reactor whose core contains a molten alloy of plutonium and iron (90 at.% Pu, 10 at.% Fe, m.p. 410°C). Reactivity control is provided using a stainless-steel reflector and four nickel control-rods located external to the core. Experiments were performed at core temperatures (isothermal) of 80, 160, and 480°C to determine critical mass and reflector worth at each of these temperatures. Control-rod worths, from period measurements, and temperature coefficients of reactivity were measured. Calculations were made, using the S_n method for solving the neutron transport problem, to determine the basic nuclear parameters of the system. The comparison between calculated and measured values of parameters such as temperature coefficient, control-element worths, and critical mass is used in evaluating the reliability of the design calculations. (auth)

26524 EXPERIMENTAL RESULTS ON LARGE DILUTE FAST CRITICAL SYSTEMS WITH METALLIC AND CERAMIC FUELS. J. K. Long, A. R. Baker, W. Gemmell, W. P. Keeney, R. L. McVean, and F. W. Thalgott (Argonne National Lab., Ill.). p.271-85 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The flexibility of the ZPR-III fast critical project permits the assembly of compositions typical of large power reactors. Oxide and carbide fuels promise attractive mechanical properties; their behavior in critical composition was studied. Central fission ratios, reactivity measurements, Rossi-α, and heterogeneity effects were determined for uranium-blanketed cylindrical cores. Some are simplified compositions useful for evaluation of cross-section sets, and others are more typical of power-reactor compositions. (auth)

26525 THE EPITHERMAL CRITICAL EXPERIMENTS. H. A. Morewitz and S. G. Carpenter (Atomics International, Canoga Park, Calif.). p.287-93 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

The present phase of the advanced-epithermal-thorium-reactor program consists of integral-reactor-physics experiments designed to provide neutron-cross-section information at 10 Mev to 1 kev range. Nine multi-region, slow-fast, pseudospherical critical assemblies of the honeycomb, split-table type are studied. Three assemblies were run. The outer driver-decoupler region drives an interior U^{233}-Th fueled spherical test region whose neutron-flux spectrum is successively degraded by increasing the graph-

ite moderator to fuel ratio. A square-wave oscillator experiment defines the central reactivity worths of 40 small samples of different materials to 10^{-5} Δk for each assembly. Intercalibrated artificial neutron sources are oscillated to determine central neutron importance functions. The spectra are obtained by fission-counter measurements using calibrated foils of different thresholds and by a Li^6-solid-state-counter sandwich spectrometer. A digital computer routine is used to compile all measurements into a self-consistent library of spectrum-averaged cross sections. (auth)

26526 DESIGN AND CONSTRUCTION OF THE ARGONNE FAST CRITICAL FACILITY (ZPR-VI). W. Y. Kato and L. R. Dates (Argonne National Lab., Ill.). p.295-312 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

In a fast-power-reactor development program, a critical facility is a highly useful tool to ascertain calculational techniques, to verify neutron cross-section sets, and to obtain integral reactor-physics parameters necessary for the nuclear design of a power system. Since it is primarily a physics instrument, the design of a fast critical facility poses problems not found in the design of a power reactor. There arise such problems as: how to obtain a large degree of flexibility consistent with safety, the determination of the size and type of facility to meet the experimental physics requirements, the determination of the number and location of control and safety rods minimizing perturbation effects, and the specification of the reproducibility of control rods and other movable components to obtain the accuracy required in reactivity measurements. These are discussed based on experience at the Argonne National Laboratory, which has under construction a fast critical facility, ZPR-VI at its Lemont, Illinois site for fast-reactor-physics studies. The ZPR-VI is a movable half- or split-table-type machine similar to ZPR-III. It has a matrix about two and a half times the volume of the earlier machine and is used to investigate the physics of large, highly-dilute, metal and cermet, unmoderated and partially-moderated systems having core volumes up to about 1500 l. A description of the ZPR-VI with a discussion on the criteria used in the design of its components from the point of view of reactor physics is presented. Management and operating procedures, potential hazards during operation, experimental techniques to be used, and construction costs are included. (auth)

26527 DESCRIPTION OF RACHEL CRITICAL ASSEMBLY. P. Bourgeois, C. Clair, R. Comte, and J. J. Long (Commissariat à l'Énergie Atomique, France) p.313-19 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

The RACHEL assembly is used for carrying out critical experiments on fast neutrons. The assembly is composed of two hemispheres of canned plutonium surrounded by a natural-uranium reflector. After the upper reflecting cap is closed slowly, criticality is achieved by the gradual insertion of four uranium rods that fill cylindrical ways in the lower reflector. Safety is ensured by provision for the rapid downward ejection of part of the lower reflector. As distance is the only form of biological protection, the hall is evacuated during experiments, the control room being situated 120 m away. (auth)

26528 NEUTRON PROPERTIES OF RACHEL CRITICAL ASSEMBLY. C. Clair (Commissariat à l'Énergie Atomique, France). p.321-5 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

The critical sizes were determined experimentally and compared with the calculated results. The effect of non-fissile structural materials was studied. (auth)

26529 RESEARCH ON NEUTRON FLUX IN EQUILIBRIUM IN NATURAL URANIUM. J. L. Campan, P. P. Clauzon, and C. P. Zaleski (Centre d'Études Nucléaires, Saclay, France). p.347-76 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Results of measurements in a block of natural uranium are presented. The detectors used are fission chambers, activation detectors, and nuclear emulsions. The following are given: measurement methods at 1 kev to 3 Mev; results of measurements of basic dimensions (diffusion length, asymptotic spectrum); and comparison with theoretical data obtained by calculations using the diffusion theory (check on validity of the theory, calculation methods and neutron constants used, etc.). The spectrum measured may be described as follows:

Diffusion length	95.25 ± 0.5	
σ_f 235/σ_f 238	230 ± 10	
σ_f 235/σ Np^{237}	14 ± 0.5	
σ_f 235/σ_f 233	0.67 ± 0.003	
σ_f 235/σ_f 239	0.9 ± 0.05	
σ_f 235/σ $In_{(n,\gamma)}$	4.8 ± 0.1	(auth)

26530 FAST-NEUTRON SPECTRA BY THRESHOLD-DETECTOR ACTIVATION. O. W. Dietrich and J. Thomas (Atomenergikommissionen, Risø, Denmark). P.377-86 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Determination of fast-neutron spectra, using threshold detectors, is investigated. A method by Hartmann approximates the neutron flux by a linear combination of the response functions (cross sections) of the detectors. Similar procedures can be made using simplified cross sections (step-functions), but assumption of the form of the spectrum is then required. A new semi-empirical method is introduced in which the reactor spectrum is expressed as a product of the fission-neutron distribution and a parameter function that takes account of the deformation of the fission spectrum in the reactor to be expected theoretically. Five threshold detectors were activated in the DR-2 (Risø), and all interpretation methods are used and intercompared. Results show that the semi-empirical method gives the most satisfactory information about the spectrum. A drawback of the activation method is the few and often poorly-known cross sections. (auth)

26531 LONG-RANGE NEUTRON-FLUX PROPAGATION IN FAST REACTORS. A. Kania, R. Pasquet, P. Pépin, J. Rastoin, and M. Solanes (Centre d'Etudes Nucléaires, Saclay, France). p.387-401 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In French)

Methods for calculation of long-range neutron-flux transmission in fast reactors are described. An attempt is made to determine the accuracy of the results; the cross-sections are not known with certainty, and the calculation codes involve finite difference equations instead of differential analytic equations. The methods are used to trace neutron-flux attenuation in mock-ups representing the RAPSODIE reactor shielding, and the calculations are compared with data. (auth)

26532 THE CORRELATION OF INTEGRAL EXPERIMENTS AND HIGH-ENERGY CROSS-SECTIONS. J. Cher-

nick, H. C. Honeck, P. Michael, S. O. Moore, and G. Srikantiah (Brookhaven National Lab., Upton, N. Y.). p.435-43 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English) (BNL-5604; BNL-5892)

The correlation of integral experiments and high-energy cross sections is discussed. The importance of integral data where cross-section measurements are inadequate is pointed out. The sensitivity of estimates of fast fission of U^{238} to inelastic cross sections and energy degradation in the Mev energy range is shown by comparison of integral data with Monte Carlo calculations. It is shown that the Snell experiment is a sensitive index to the absolute values of inelastic cross sections above 1.4 Mev. The results of attempts by the Brookhaven Cross-Section Evaluation Group to reconcile measurements of inelastic cross sections of U^{238} are given. Other areas where integral data and critical experiments can be used to reduce computational uncertainties are the fast effect in beryllium, and η of U^{233} at intermediate energies. Critical experiments can reduce the present uncertainty in Be (n,2n) cross-sections and in intermediate energy values of η_{23}. (auth)

26533 STATUS OF COMPUTATIONAL AND EXPERIMENTAL CORRELATIONS FOR LOS ALAMOS FAST-NEUTRON CRITICAL ASSEMBLIES. G. E. Hansen (Los Alamos Scientific Lab., N. Mex.). p.445-55 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (TID-13176). (In English)

Direct correlations among data are presented to indicate possibilities for correlations with computations. Sensitivities of computed spectra and critical sizes to neutron-transport models and arithmetic approximations are presented for typical assemblies to help establish computational detail. Comparisons between experiment and prediction include spectral indices, critical sizes, neutron lifetimes, and delayed-neutron fractions. (L.N.N.)

26534 RECENT ADVANCES AND PROBLEMS IN THEORETICAL ANALYSES OF ZPR-III FAST CRITICAL ASSEMBLIES. D. Meneghetti (Argonne National Lab., Ill.). p.457-87 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962. (In English)

Theoretical analyses of critical assemblies studied experimentally on the Argonne Zero Power Facility, ZPR-III, are compared with measured data. Discrepancies between calculated and experimental values are examined with results from previous assemblies for systematic trends. Effects of modifications in the cross-sections and in the calculational procedures in reducing the discrepancies are discussed. Calculation of reactivity changes, flux variations, and detector-response variations resulting from the heterogeneities caused by various intra-drawer configurations of fuel and diluent plates within the drawers of the critical assemblies are compared with experimental data. Transport methods for such thin slab cell configurations are compared. Improvements in the calculational methods for these cells are suggested; a simple multi-group approximation method, amenable to hand calculation, is described. The sensitivities of reactivity and inhours as functions of asymptotic reactor periods are examined for fast-reactor compositions. Results of calculations of effective delayed-neutron fraction, inhours per cent k_{eff}, and prompt- and delayed-neutron worths are given for fast assemblies. (auth)

26535 PHYSICS OF FAST AND INTERMEDIATE REACTORS. VOL. II. Proceedings of the Seminar on the Physics of Fast and Intermediate Reactors, held in Vienna, 3-11 August 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Mar. 1962. 407p. (STI/PUB/49(Vol.II)). $9.00(IAEA).

Reactor theory is discussed. Separate abstracts are prepared for 18 papers; one paper was previously abstracted for Nuclear Science Abstracts. (L.N.N.)

26536 CALCULATION METHODS FOR FAST AND INTERMEDIATE REACTORS. G. I. Marchuk (Academy of Sciences, Moscow). p.3-26 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Methods for calculating intermediate and fast reactors are discussed. Approaches to the problems of physical calculation are presented. Calculation of resonance effects is discussed. Consideration is given to multi-group systems of fundamental and conjugate equations, applications of perturbation theory to the problems of physical reactor calculation, and numerical methods of solving fundamental and conjugate reactor equations, which approximate the method of spherical harmonics. The response method is applied to the solution of critical-mass problems and methods of calculating reactors with hydrogeneous moderators. The fundamental features of an effective one-group reactor model are described. (auth)

26537 MULTI-GROUP CALCULATIONS FOR FAST REACTORS. P. Moinereau and M. Solanes (Centre d'Etudes Nucléaires, Saclay, France). p.27-53 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

Causes of error in calculations are discussed. The mathematical approximations (diffusion approximation, S_n method, etc.), the numerical resolution methods (effect of integration step), the models used, and the implications of these factors in the determination of the principal characteristics of a fast neutron reactor are explained. The effect on reactivity of variations of element cross sections, using various fuels in reactors of hard spectra, is examined. (auth)

26538 MULTI-GROUP NEUTRON TRANSPORT THEORY. R. Zelazny and A. Kuszell (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). p.55-71 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The general theory of the application of the K. M. Case method to N-group neutron transport theory in plane geometry is given. The eigenfunctions (distributions) for the system of Boltzmann equations were derived, and the completeness theorem was proved. By a general solution, two examples important for reactor and shielding calculations, solutions of a critical and an albedo problem for a slab, are given. The system of singular integral equations for expansion coefficients into a full set of eigenfunction distributions was reduced to the system of Fredholm-type integral equations. Results can be applied to spherical problems. (auth)

26539 THE VALIDITY OF THE TRANSPORT APPROXIMATION IN CRITICAL-SIZE AND REACTIVITY CALCULATIONS. E. D. Pendlebury and L. H. Underhill (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.73-84 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Elastically scattered neutrons are not, in general, distributed isotropically in the laboratory system, and a convenient way of taking this into account in neutron-transport calculations is to use the transport approximation. In this,

the elastic cross section is replaced by an elastic transport cross section with an isotropic angular distribution. This leads to simplification in the neutron-transport calculation. Theoretical bases of the transport approximation in one-group and many-group formalisms are given. The accuracy of the approximation is studied in the multi-group case for typical systems, by the S_n method using the isotropic and anisotropic versions of the method, which exist as alternative options of the machine code SAINT written at Aldermaston for IBM-709/7090 machines. The dependence of the results of the anisotropic calculations on the number of moments used to represent the angular distributions is examined. Results of calculations are discussed, and an indication is given of the types of system for which the transport approximation is adequate and of those for which it is inadequate. (auth)

26540 THE REACTIVITY OF A CENTRAL AIR GAP IN A BARE REACTOR. H. Haeggblom (Aktiebolaget Atomenergi, Sweden). p.85-94 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Two methods are presented for calculation of the reactivity equivalence of a central gap in a bare reactor with rectangular cross section. The first is a perturbation theory; the second is an application of variation calculus. The eigenvalue is solved for the transport equation in integral form. The principal difference between the two methods is in the assumption for the flux shape. In the perturbation theory, it is assumed that the flux is unperturbed and has the form A cos $\pi x/L$. The reactivity as a function of the gap width is expressed in closed form in one and two energy groups, but the expression is valid only for reactivity changes less than about 8%. The variation calculus is developed only for one energy group, but the accuracy is approximately independent of the gap width. This is obtained by varying the expression for the flux in order to optimize the functional integral. The results are compared with those obtained by Chernick and Kaplan by diffusion theoretical methods. (auth)

26541 THE SENSITIVITY OF CALCULATED CRITICAL MASSES OF SMALL FAST SYSTEMS TO CHANGES IN THE U^{235} AND U^{238} NEUTRON-SCATTERING DATA. E. D. Pendlebury (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.97-110 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The sensitivity of the calculated critical masses of simple systems to changes in the basic neutron scattering data were investigated. The systems considered are spheres of 29% U^{235} and 93½% U^{235}, both bare, and reflected by thick natural uranium. The calculations were carried out using the Carlson S_n method with 4 energy groups, and the percentage changes in the calculated critical masses of the different systems, due to specified changes in the aspects of the neutron scattering data, were obtained. The results are presented and discussed with particular reference to the adjustment of the basic data to agree with experimental critical sizes. (auth)

26542 THE EFFECTS OF ERRORS IN CROSS-SECTION DATA ON CALCULATIONS FOR A LARGE DILUTE FAST REACTOR. T. P. Moorhead (Atomic Energy Establishment, Winfrith, Eng.). p.111-45 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Agency, 1962. (In English)

The neutron physics of a fast reactor having 1500 l core containing about 1000 kg of plutonium were calculated using five-group diffusion theory. The effect on the critical size and breeding ratio of varying each cross-section in turn was determined. The most important use of the results is to indicate the accuracy required for the cross-section data used in this type of calculation, but they can also be used to estimate the effect on the reactor of small changes in core composition or neutron spectrum. (auth)

26543 REACTIVITY COEFFICIENTS BY PERTURBATION THEORY. J. W. Webster (International Atomic Energy Agency, Vienna). p.149-64 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The formulation of perturbation theory is reviewed as a method of calculating reactivity coefficients; this consists mainly of developing the differential equation for the adjoint flux, as a continuous function of position and lethargy, by proceeding by analogy from the one-group differential equation for adjoint flux. The two-group form of perturbation theory is applied to a boiling-mercury-cooled fast-breeder reactor (MCBR). The net Hg density coefficient of reactivity for the first-design-try for the MCBR is negative for some regions and positive for others. However, it is negative for regions of highest statistical weight and where the density change for a power change would be the greatest. The overall Hg density coefficient is thus negative, i.e. the void coefficient is positive—an unsafe condition. Design changes made to obtain a design having a negative void coefficient are discussed. (auth)

26544 THE REACTIVITY EFFECT OF HYDROGEN-ADDITION IN FAST REACTORS. H. Soodak (United Nuclear Corp., White Plains, N. Y.). p.165-76 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The addition of small amounts of hydrogen into a fast reactor results in a reactivity gain from the decreased leakage at lower energies and a reactivity loss due to the decrease in k_∞ at lower energies. In large reactors having high ratios of fertile to fissionable material, the leakage effect may be smaller than the k_∞ effect leading to a decrease in reactivity due to the addition of small amounts of hydrogen. In smaller reactors having lower ratios of fertile to fissionable material, the leakage effect is larger than the k_∞ effect, and the hydrogen coefficient is positive. For larger amounts of hydrogen addition, neutrons are thrown into the resolved resonance region where k_∞ increases because of the greater self protection in fertile than in fissionable material; the reactivity effect becomes more positive. Results concerning these effects are presented; the effect of the addition of large amounts of hydrogen (flooding) is discussed. (auth)

26545 REACTIVITY COEFFICIENTS OF SODIUM IN SOME LARGE FAST REACTORS. M. G. Bhide (Atomic Energy Establishment, Trombay, India) and H. H. Hummel. p.177-86 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Studies were made regarding the change of reactivity in fast reactors with the temperature of sodium or with the loss of coolant. Effects on the sodium void coefficient of taking into account the effect of elastic resonance scattering by light and medium atomic-weight materials is studied for large fast systems. Fundamental-mode calculations were performed for the different sodium concentrations in the systems using 574 energy groups from 3.7 Mev to 25 kev. The elastic removal and transport cross sections were re-evaluated for a 16-group cross-section set, and the reactivity coefficients were calculated using a one-dimensional diffusion-theory code for the idealized

spherical systems. A more accurate calculation of the very-low-energy flux is provided. This flux is important for calculation of the Doppler effect in large reactors. (auth)

26546 LONG-TIME BEHAVIOUR OF FAST BREEDERS. K. Ott and A. Jansen (Kernforschungszentrum, Karlsruhe, Ger.). p.213-28 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

For studying the long-time behavior of fast breeders, an 0-dimensional model of fissile (plutonium), fertile (U^{238}) and absorbing material (structural material and coolant) is investigated. Charging, discharging, and re-charging of fissile and fertile material are idealized as continuous processes. Criticality requires continuous discharge of each specific Pu-composition. The time behavior of the isotope composition is described by a first-order-differential-equation system whose solution was determined numerically for different initial conditions. Calculating the stationary isotope composition (stationary after a long time) leads to an eigenvalue problem with the plutonium current to be discharged as eigenvalue and the Pu-isotope concentrations as eigenvector components. Generally, this eigenvalue problem has but one physically-reasonable solution with "Pu^{∞}" as eigenvector. The eigenvalue determines the breeding rate. The principal structure of fuel recycling is investigated. (auth)

26547 FISSION GAS PRESSURE BUILD-UP AND FAST BREEDER ECONOMY. P. Engelmann (Kernforschungszentrum, Karlsruhe, Ger.). p.229-45 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Fuel-cycle costs and doubling time of fast-breeder reactors are strongly affected by the fuel burn up obtainable. Use of oxide or carbide fuel offers the possibility of reaching a burn up of 100 000 Mwd/t. In fuel-clad elements, a limiting factor is the fission-gas-pressure build-up. At the high burn-up considered, an appreciable fraction of the fission gases gets into the pores and contributes to the pressure on the can. Starting from the known fission-product yields and decay chains, gas production and pressure build-up were calculated. Three physical models were employed in calculating the pressure acting upon the can: the gas is contained either in interconnected pores, in separate pores, or in a central hole. The pressure dependence upon free volume (fuel density) and temperature is discussed. Cans made of high-strength materials as Inconel-X and molybdenum could stand the fission-gas pressure at operating temperatures. These materials have higher absorption cross sections than stainless steel. Results of a multi-group calculation are given, showing the effects of these can materials and of decreasing the fuel density on critical mass and breeding ratio in small and medium-size breeders. (auth)

26548 FISSION-PRODUCT BURN-UP IN FAST REACTORS. M. M. Levine (Brookhaven National Lab., Upton, N.Y.). p.247-55 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

In fast reactors where breeding is emphasized, the burn-up of fission products can be important. Statistical estimates of fission-product cross sections are combined with yield data for fissionable species, to estimate the gross fission-product cross section as a function of irradiation time in fast reactor spectra using various fuels. Because of gaps in yield data for some fuel species, it is necessary to interpolate on the yield curves in some cases. The chain yield for a given mass is then apportioned among the chain members using the equal-charge displacement method. The cross-sections estimated for U^{235} fission products are supplemented by estimates for fission products important for other fuels. A range of such spectra is considered. These spectra are characterized by the index (average $(E^{-\frac{1}{2}})$) in the spectra. The sensitivity of the gross poisoning and its burn-up with respect to spectrum variations are considered. The results are also expressed in terms of pseudo-fission products, so that changes in effective cross-section of fission products with irradiation were considered simply. (auth)

26549 EFFECT OF THE PLUTONIUM ISOTOPIC COMPOSITION ON THE PERFORMANCE OF FAST REACTORS. S. Yiftah (Israel Atomic Energy Commission). p.257-70 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

The isotopic composition of plutonium to be used as fuel for fast reactors will depend on the source of plutonium. Production reactors, thermal power reactors using natural uranium or enriched uranium as fuel, and fast reactor blankets are available as sources. In general, source (a) and to some extent source (c) will provide relatively "clean" plutonium, that is mostly Pu^{239}, while plutonium from source (b) will be "dirty" plutonium, that is plutonium rich in Pu^{240}, Pu^{241}, and Pu^{242}. The degree of "dirtiness" will depend on the kind of reactor, amount of burn-up, and, in general, on the irradiation history of the fuel. To investigate the effect of different isotopic composition of the plutonium fuel, in the metallic, oxide and carbide form, on the performance of fast reactors, a limited series of spherical geometry 16-group diffusion theory calculations was performed, using a 16-group cross-section set developed recently and taking three different kinds of plutonium, starting with pure Pu^{239} and increasing the amount of higher isotopes. For the systems studied, 800, 1500, and 2500-l core-volumes, which are typical for large fast power reactors, the result is, taking into account only the thermally fissionable isotopes Pu^{239} and Pu^{241}, that the "dirtier" the plutonium, the smaller the critical mass and the higher the breeding ratio. For the 1500-l reactor, in the metallic, oxide, and carbide plutonium fuels, the reactivity change upon removal of 40% of the sodium initially present in the core is made more negative (or less positive) when the plutonium is richer in higher isotopes. (auth)

26550 PERFORMANCE OF LARGE FAST POWER REACTORS INCLUDING EFFECTS OF HIGHER ISOTOPES, RECYCLING AND FISSION PRODUCTS. D. Okrent (Argonne National Lab., Ill.). p.271-97 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Using a 16-group cross-section set, the initial and long-term performance of large, fast-power reactors is examined. The build-up of higher isotopes of plutonium as a function of core-feed material and reactor design is analyzed, and the influence of changing plutonium isotopic composition on critical mass, breeding ratio, reactivity, coolant void coefficient, and delayed-neutron fraction will be treated. The sensitivity of these results to neutron-cross-section data is discussed in the light of measurements of $\alpha = \sigma_c/\sigma_f$ of Pu^{239} and by making arbitrary changes in the least-certain multi-group cross sections. The effects of fission-product build-up on critical mass, breeding ratio, and reactivity are calculated. Measurements with mock fission products at ZPR-III are correlated and compared with predictions based on the estimates of theoretical nuclear physics. The reactivity growth associated with blanket plutonium build-up, the sensitivity of the sodium

void coefficient to reactor-core composition, and the high-energy spectrum (>1.4 Mev) of such reactor systems are discussed. (auth)

26551 SOME STUDIES OF FAST POWER REACTORS. A. Kania, P. Moinereau, G. Vendryès, and C. P. Zaleski (Centre d'Etudes Nucléaires, Saclay, France). p.301-56 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In French)

After neutron studies on fast reactors of 800 Mw thermal, in which changes were made in the type of fuel (metal, carbide, oxide, cermets) and in the shape and dimensions of the core, an attempt to determine the factors affecting the price per kw of power produced under these conditions was made. Effects of the breeding ratio, the permissible irradiation rate, and the specific power are studied. Optimum values of the latter for adoption in fast power reactors, are given. (auth)

26552 SOME PHYSICS ASPECTS OF CERMET AND CERAMIC FAST SYSTEMS. J. Codd, M. F. James, and J. E. Mann (United Kingdom Atomic Energy Authority, Eng.). p.357-71 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Characteristics of a system using an iron-based oxide cermet as fuel material are discussed. A transport theory investigation to develop methods of predicting the effect of core heterogeneity on reactivity and flux distribution is described. Calculations are given on resonance self-shielding and Doppler temperature effects in a cermet system. (auth)

26553 THE PHYSICS ASPECTS OF A COUPLED FAST-THERMAL STEAM SUPERHEATING REACTOR. B. J. Toppel and R. Avery (Argonne National Lab., Ill.). p.373-407 of "Physics of Fast and Intermediate Reactors. Vol. II." Vienna, International Atomic Energy Agency, 1962. (In English)

Physics calculations were performed on a light-water version of the coupled steam superheater using 13-group, one-dimensional and 4-group, two-dimensional diffusion theory in cylindrical geometry. The 13-group cross sections were obtained using an iterative procedure employing fundamental mode flux results. The 4-group cross sections were obtained by collapsing the 13-group set using spectra from results of a 13-group, one-dimensional calculation. In the steam-cooled zones, the regional cross-sections were obtained by simple homogenization. In the water zones, attention was given to heterogeneity when obtaining appropriate regional cross-sections. A comparison of the 4-group and 13-group results is presented. The agreement is generally good, although there is indication that the resonance capture considerations in the 4-group calculations need refinement. The calculated initial breeding ratio is 1.4, a value typical of fast and coupled systems, and comparable with the value obtained for the heavy-water version of the system. This large breeding ratio is realized because of the small water density and large power fraction in the fast core, and because of the large fuel density in the thermal zones. Calculations of the prompt-neutron lifetime, division of reactivity, and coupling parameters are discussed. Reactivity coefficients for water addition in the fast and thermal regions are presented. These coefficients are significant in the safety of the concept. (auth)

26554 PHYSICS OF FAST AND INTERMEDIATE REACTORS. VOL. III. Proceedings of the Seminar on the Physics of Fast and Intermediate Reactors, held in Vienna, 3-11 August 1961. (International Atomic Energy Agency, Vienna). Proceedings Series. Mar. 1962. 628p. (STI/PUB/49(Vol. III). $12.00(IAEA).

Reactor dynamics and physics of specific reactors are discussed. Separate abstracts are prepared for 16 papers; two papers were previously abstracted for Nuclear Science Abstracts. (L.N.N.)

26555 INFLUENCE CURVES FOR CALCULATION OF THE STRUCTURAL DISTORTION EFFECT ON REACTIVITY. F. Storrer (Belgonucléaire, Brussels). p.3-17 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

Thermal structural expansion and distortion play a basic role in the feedback loop of fast reactors. They are pronounced because of the high figures of temperature increase, and the larger the portion of neutrons which escape from a given unit volume of the core, the greater is their effect on reactivity. The calculation of the structural distortion effect on reactivity is complicated in the case of transients, because the spatial temperature distribution varies with time and the structure is generally hyperstatic to a very great extent. The calculation is more simple if influence curves are first calculated showing the reactivity corresponding to distortion caused by unit point perturbation, either of the temperature or the radial temperature gradient. These influence curves are analogous, in respect of overall structural distortions, to the curves giving local temperature coefficients. On the basis of these curves, the reactivity corresponding to an arbitrary temperature distribution may be obtained by means of simple integration. Examples are given showing these curves and the method used for obtaining them. (auth)

26556 THE EFFECTIVE LIFETIME AND TEMPERATURE COEFFICIENT IN A COUPLED FAST-THERMAL REACTOR. W. Haefele (Kernforschungszentrum, Karlsruhe, Ger.). p.19-32 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

The theory of coupled systems was extensively developed by Avery, et al., at the Argonne National Laboratory. In a coupled system, a longer effective lifetime of neutrons is obtained. The effect of the thermal component acts as a neutron-delayer. As in the theory of delayed neutrons, the delaying effect disappears if the reactivity worth is high enough to make the fast component critical by itself. A coupled reactor is considered in which the fast component suffers a sudden reactivity step a_0. Because of the increasing power-level, the temperature rises and the temperature coefficient of the fast component and of the thermal component become effective. The problem is considered with one group of delayed neutrons (in the ordinary meaning). A formalism is given to express the effective lifetime and temperature coefficient during the different stages of the excursion. Excursions for different a_0 are given so that the limit of fast-reactor kinetics is reached. (auth)

26557 STUDY OF THE KINETICS OF A RESEARCH REACTOR BY THE PROBABILITY METHOD. A. I. Magil'nev. p.33-40 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In Russian)

Among the statistical methods used to determine kinetic parameters of critical and near-critical assemblies, the most suitable for the intermediate energy range is the Feynman alpha method, which is based on measurement of the relationship between relative dispersion $(\overline{n^2} - \overline{n}^2)/\overline{n} = 1 + \Psi(t)$ in the number of counts n for a given interval of time, and the duration of the interval (t). Dispersion measurements were carried out by direct recording of the number of pulses in the intervals, and involved a laborious

process of squaring the numerous data obtained. In order to obtain the value of $\alpha = (1 - k_p)/l$, Lukov processed data for $\sim 10^4$ intervals. Dispersion values are obtained indirectly by applying the law of distribution for the number of counts, as distinct from Poisson's law. The laborious operations needed to obtain the data can be performed automatically in the process of measurement. A five-channel statistical analyzer is described. This device, which is constructed of the simplest elements (triggers), can carry out the operations simultaneously for five different intervals. Thus, even in the case of a thermal reactor, processed data for $\sim 3 \times 10^5$ intervals can generally be accumulated in five minutes, which guarantees a high degree of statistical precision and permits a better utilization of the information obtained. In the intermediate-energy range, data can be processed for more than 10^6 intervals in the same period of time. Examples of the application of statistical analysis and results of measurements made using a multi-channel statistical analyzer are given. (auth)

26558 AN ANALYSIS OF THE STABILITY OF EBR-I, MARKS I TO III, AND CONCLUSIONS PERTINENT TO THE DESIGN OF FAST REACTORS. R. R. Smith, R. G. Matlock, F. D. McGinnis, M. Novick, and F. W. Thalgott (Argonne National Lab., Ill.). p.43-91 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

A re-examination of the instabilities noted in EBR-I, Marks I and II, resulted in a physico-mathematical feedback model describing the frequency-dependence and the intensity of resonant effects. Features responsible for the instabilities may be directly attributed to two features of mechanical design. One concerns the existence of a perforated shield-plate system which controlled reactivity through the delayed expansion of ligaments contiguous with fuel-rod extensions. The effects of both were manifested, respectively, by two distinct power-coefficient components: one negative and strongly delayed; and the other, positive and prompt. The combination of the two resulted in a feedback which permitted constructive interference between input and feedback reactivities. The results of stability tests conducted on Mark III strongly substantiate this conclusion since the elimination of the shield-plate system and the addition of stabilizing ribs to the fuel rods resulted in a system which displayed none of the undesirable features characterizing earlier loadings, and which was exceedingly stable under all credible operating conditions. The stability of fast systems may be controlled completely by proper mechanical design. Careful planning, with emphasis placed on fuel-rod motion, should be sufficient to guarantee the stability of future fast reactors. (auth)

26559 STUDIES ON THE TRANSIENT OPERATION AND STABILITY OF FAST REACTORS. R. Abdon, J. M. Chaumont, P. P. Clauzon, and G. Ghesquiere (Centre d' Etudes Nucleaires, Saclay, France). p.93-105 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In French)

Calculation methods for fast reactors are perfected. Basic formulas are given for the classic kinetic and thermal exchange equations, etc. A description is given of the digital computer methods employed for studying the stable functioning of the reactor and of the methods used for transient operation studies. Examples of application are discussed, and a comparison is made with parallel studies. (auth)

26560 STABILITY ANALYSIS OF EBR-II. H. H. Hummel and L. T. Bryant (Argonne National Lab., Ill.). p.107-17 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

Transfer function calculations were carried out for the EBR-II using reactivity coefficients derived from distributed worths of fuel, sodium, and steel measured on the ZPR-III, taking into account temperature variation in the core. Temperature calculations are performed on an IBM-704 using the method of Storrer and on an analogue computer. In the former case, a more detailed description of the reactor is possible, but only linear problems can be considered. Time constants based on the steady-state temperature distribution in a two-region pin with fuel and clad regions give, when used in a radially-lumped pin model, axial temperature distributions which agree with the exact calculations up to a frequency of 5 radians/sec. For the EBR-II pin, the effect of the clad on the time constants is significant. The only feedback mechanism for which calculations were made is a linear one corresponding to unrestrained thermal expansion. Because of the short time lags involved, no instability in the reactor seems possible. Bowing and irregular radial expansion of the core are possible sources of non-linearity in the feedback. (auth)

26561 THE DOPPLER EFFECT IN A LARGE FAST OXIDE REACTOR. ITS CALCULATION AND SIGNIFICANCE FOR REACTOR SAFETY. P. Greebler and B. A. Hutchins (General Electric Co., San. Jose, Calif.). p.121-38 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

The negative Doppler temperature coefficient of a large PuO_2-UO_2-fuelled fast reactor provides a safety advantage. With appropriate selection of core size and composition, the prompt Doppler coefficient completely overrides delayed reactivity effects due to thermal expansion of sodium and other core materials. The significance of the Doppler coefficient for reactor safety is indicated by its effectiveness in limiting the fuel temperature rise during prompt-critical power transients initiated by accidental expulsion of control rods or of sodium coolant. Selection of design parameters and operating conditions (such as refuelling schedule) for reactor safety and stability is discussed on the basis of these calculated power transients. The strong Doppler effect in a large fast oxide reactor results from the degradation of the neutron spectrum and the ability to use a low Pu^{239} to U^{238} ratio. Techniques used to calculate the negative contribution to the Doppler coefficient by U^{238} and Pu^{240} and the positive contribution by Pu^{239} are described, and multi-group cross sections for these isotopes are given as functions of fuel temperature and of isotopic concentrations. The calculational techniques include the effects on the Doppler power coefficient of the spatial variation of neutron flux and importance, and of power and fuel temperature in an operating reactor. (auth)

26562 THE DOPPLER EFFECT OF PLUTONIUM-239 IN FAST REACTORS. E. A. Fossoul (Belgonucleaire, Brussels). p.139-51 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In French)

The Doppler effect of Pu^{239} in a fast spectrum was studied. Following Goertzel, Lane and Bethe, and the formulation proposed by Nicholson, the Doppler effect of Pu^{239} at 1 to 200 kev was evaluated. At these energies, the total macroscopic cross-section $\mu_t(E)$ scarcely deviates from its mean value $(\mu_t(E))$, and the contribution to the Doppler effect by the group of neutrons centered on energy E can be evaluated by Nicholson's method "A." The function $Q_t^{(c)}$ is calculated on the basis of findings regarding the resonances of Pu^{239}. (auth)

26563 A REVIEW OF THE NUCLEAR ASPECTS OF FAST-REACTOR SAFETY. D. Okrent (Argonne National Lab., Ill.). p.155-69 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

The progress, status, and problems in fast-reactor safety are discussed. The status of studies into the nuclear side of safety is examined. Developments in the safety of moderate-sized, metal-fuelled reactors are treated, including questions of stability, core melt-down, autocatalytic effects and explosion calculations. The choice of a "maximum accident" for such reactors is examined. Changes in safety characteristics arising from different fuel-element types and for large reactors are reviewed, including questions of zero fuel expansion, positive sodium reactivity coefficients, and the Doppler effect. The influence of these changed safety characteristics on design and on hazards evaluation is discussed. The outstanding safety problems facing fast reactors are listed. (auth)

26564 THE FAST-REACTOR SAFETY PROGRAMME IN TREAT. C. E. Dickerman, D. Okrent, and E. Sowa (Argonne National Lab., Ill.). p.171-93 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

Because of the difficulties of specifying theoretically the phenomena of a fast-reactor melt-down incident, experimental investigations are under way to study the mechanisms involved in fuel-element failure and subsequent movement of fuel. An in-pile program is under way using TREAT, a special pulsed engineering test reactor built to provide a high integrated neutron flux over a large sample volume under transient conditions. Special techniques are being developed to follow the course of melt-down experiments. Tests were performed on EBR-II Mark I elements (clad with stainless steel, tantalum or niobium) and metallurgically-bonded zirconium clad Fermi-I samples. Early results are reviewed, data presented, and their significance discussed. Failure of EBR-II elements suggested a new type of hypothetical melt-down accident, not apparent from out-of-pile tests. Differences in EBR-II element failure produced by replacing steel by tantalum or niobium, and the characteristically different phenomena associated with Fermi-I samples are consistent with predictions of a simple model of element failure, incorporating a diffusion controlled mechanism of cladding dissolution by molten fuel and experimental data on cladding penetration. (auth)

26565 MAJOR ACCIDENT ANALYSES FOR EXPERIMENTAL ZERO-POWER FAST REACTOR ASSEMBLIES. G. Fischer, E. W. Barts, S. Kapil, and K. Tomabechi (Argonne National Lab., Ill.). p.195-207 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

A study was made of the possibility, mechanism, and consequence of melt down and other major nuclear accidents for a ZPR-III type experimental zero-power fast reactor of the two-half type. This was supplemented by an evaluation of the importance of the Doppler effect for a wide range of nuclear reactor assemblies for such a reactor. A melt-down event is highly improbable because of the restricted sequence of events postulated. A discussion of the mechanism of the collapse is followed by the results of coupled neutronics-hydrodynamics calculations for two zero-power assemblies. A 1200-l core was examined because it represents a relatively large reactor of common core composition. A smaller core with a high-void fraction was examined as a potentially more dangerous system. Different time-wise behavior was found for the two systems. For sharp accidents in zero-power assemblies, the U^{235} atoms, separated as plates of enriched uranium, heat very rapidly while the remainder of the core remains essentially cold, so that a gas of U^{238}-vapor provides the disassembly pressure. The adaption of the neutronics-hydrodynamics code AX-I to the use of a Van der Waals gas is described. Another change in the equation of state used in the code is to employ a Mie-Grüneisen type equation derivable from solid state theory. This change provides a more satisfactory way to evaluate the pressure term for cores of variable composition. Because the highly enriched U^{235} plates of a zero-power assembly heat much more rapidly than the depleted uranium plates, the possibility of a net positive Doppler effect is much larger for an experimental assembly than for the equivalent power breeder reactor. This hazard was examined for possible assemblies. These calculations indicate that the Doppler coefficient for a zero-power assembly does not become important as a hazard until systems with the very soft neutron-energy spectra characteristic of large oxide power breeders are approached. (auth)

26566 PHYSICS OF THE DOUNREAY FAST REACTOR. D. C. G. Smith (Dounreay Experimental Reactor Establishment, Caithness, Scotland). p.241-61 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

A description of the Dounreay fast reactor and its experimental facilities is given, followed by a survey of the experiments carried out during the low-power commissioning of the reactor. Calculations are described and comparison is made between predicted and observed results. In general, the theoretical methods predict reasonably well the neutron energy spectrum and the distribution of reaction rates in the core but underestimate the total flux and the softness of the spectrum in regions outside the core. Anomalies were found when the calculated and measured quantities disagreed by factors lying outside the expected erron of calculation and measurement. (auth)

26567 PHYSICAL CHARACTERISTICS OF THE BR-5 REACTOR. A. I. Leipunskii, O. O. Kazachkonskii, A. I. Abramov, et al. p.315-34 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In Russian)

The BR-5 reactor is an experimental fast reactor having a thermal capacity of 5000 kw. Its fuel is plutonium oxide, and the coolant is sodium. The reactor's reflector consists of a thin layer of natural uranium surrounded by a thick layer of nickel. The physical features of the reactor as measured during start-up and operation are described. The neutron flux at the center of the core is 8.2×10^{14} n/cm^2 s. Results of studies of the reactor's kinetics, its temperature and power coefficients, and the distribution of the number of fissions and reaction rates of various reactions over the core volume are presented. Neutron fluxes and spectra were measured in the reactor's experimental assemblies. (auth)

26568 ADVANCED EPITHERMAL THORIUM REACTOR (AETR) PHYSICS. A. V. Campise (Atomics International, Canoga Park, Calif.). p.335-54 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In English)

The AETR concept is reviewed in reference to theory, nuclear parameters, and potential neutron economy. The effect of thorium resonance capture in graphite-moderated systems with median absorption energies at 0.10 to 100 kev were studied. Narrow-resonance (NR) and wide-resonance (NRIA) formulations are used to obtain the temperature-dependent effective resonance integral of thorium rods, which are expressed as equivalent multi-group cross-sections. The need for nuclear data in the intermediate

energy range led to design and construction of a critical assembly. Nuclear design of this assembly emphasizes the importance of cross-section data and the theoretical interpretation of these experimental results, both pertinent to the design of an AETR. The accuracy of the analytical techniques was demonstrated in the analysis of ZPR-III experimental results. Three heat-transfer configurations are compared using doubling time as an optimizing parameter. The effect of Pa^{233} and uranium-isotopes production on relative neutron economy, potential breeding ratios, and burnup characteristics are evaluated in regard to the uncertainties in the nuclear cross-sections. (auth)

26569 PHYSICAL RESEARCH ON RAPSODIE. J. L. Campan, J. M. Chaumont, P. P. Clauzon, G. Ghesquiere, A. Kania, S. G. Kaufmann, P. Moinereau, A. P. Schmitt, M. Solanes, and C. P. Zaleski (Centre d'Études Nucléaires Saclay, France). p.355-98 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In French)

A review of the research on the physics of the RAPSODIE fast reactor, to be constructed at the Cadarache Nuclear Research Centre, is given. Reasons for selecting and designing this type of reactor are discussed. An account of neutron studies, including critical masses, spectra, neutron economy, fuel development and plutonium production, reactivity co-efficients and control methods is given. Results of research on stability and dynamic behavior (reactor shutdown, dropping of rods) and on explosion accidents are discussed. (auth)

26570 A PULSED FAST REACTOR. G. E. Blokhin, D. I. Blokhintsev, Yu. A. Biyumkina, et al. p.399-417 of "Physics of Fast and Intermediate Reactors. Vol. III." Vienna, International Atomic Energy Agency, 1962. (In Russian)

A pulsed fast reactor is used as a pulsed neutron source for physical experiments carried out by the time-of-flight method. It is used for total cross-section and intermediate neutron capture cross-section measurements, for studying the interaction between slow neutrons and solids and liquids, and for measuring neutron spectra produced in various media. The basic structural features of the reactor and the results of the experiments for which it is used are described. The reactor's operating system is based on recurrent pulses. Power pulses are produced when the mobile part of the reactor core moves swiftly through the stationary part of the core. The mobile part of the core is fastened to a rotating disc and travels at a speed of 230 m/s. The frequency of power pulses can be altered by an auxiliary mobile zone having a range of 2.3 to 88 pulses per sec. The mean power of the reactor is 1 kw, and the half-width of the power pulse in 36 μsec. The reactor has a control and safety system that ensures automatic maintenance of mean power and swift shutdown in the event of any operational irregularity. It is fitted with a system of evacuated-neutron-flight tubes used in time-of-flight experiments. The main tube is 1000 m in length. In the start-up process and during physical experiments carried out on the reactor, the influence on reactivity of displacing the controls and the mobile parts of the core was studied; the length of the pulse was measured under various operating conditions, and power pulse amplitude fluctuations were studied. Measurements were made to establish the lifetime of prompt neutrons, the effective fraction of delayed neutrons, and coefficients of reactivity. (auth)

26571 CONCENTRIC TUBULAR NUCLEAR FUEL ELEMENTS. (to U. S. Atomic Energy Commission). British Patent 901,667. July 25, 1962.

A concentric tubular fuel element for organic moderated reactors is designed which gives relatively uniform heat generation and temperature distribution. The fuel element comprises a plurality of spaced concentric fuel tubes, each having fins twisted into spirals in opposite directions to provide annular coolant channels. Inner and outer tubes are provided to hold the assembly together, and control rods may be inserted into the central region. Dimensional data are given for a 45.5 Mw(t) terphenyl-cooled reactor using fuel elements of this type. (D.L.C.)

26572 IMPROVEMENTS IN OR RELATING TO SHOCK ABSORBERS. James Simon Picton and Anthony James Taylor (to Babcock and Wilcox Ltd.). British Patent 901,868. July 25, 1962.

A shock absorber is designed for preventing damage from falling fuel elements or control rods in a gas-cooled reactor. The shock is absorbed by breaking of a shear pin and expansion of a tube. (D.L.C.)

26573 IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. William Kenneth Bolton and Frederick Wilde (to A.E.I.-John Thompson Nuclear Energy Co. Ltd.). British Patent 901,893. July 25, 1962.

A fuel element for gas-cooled reactors is designed which enables the maximum fuel temperature to be reduced for the same heat output. The element comprises an assembly of four fuel rods supported in a hollow cylindrical casing on two support rods extending diametrically across the casing. (D.L.C.)

26574 CRUCIFORM CONTROL ROD JOINT. A. G. Thorp, II (to U. S. Atomic Energy Commission). U. S. Patent 3,048,532. Aug. 7, 1962.

An invention is described which relates to nuclear reactor control rod components and more particularly to a joint between cruciform control rod members and cruciform control rod follower members. In one embodiment this invention provides interfitting crossed arms at adjacent ends of a control rod and its follower in abutting relation. This holds the members against relative opposite longitudinal movement while a compression member keys the arms against relative opposite rotation around a common axis. Means are also provided for centering the control rod and its follower on a common axis and for selectively releasing the control rod from its follower for the insertion of a replacement of the control rod and reuse of the follower. (AEC)

26575 NEUTRONIC REACTOR MANIPULATING DEVICE. Lee A. Ohlinger (to U. S. Atomic Energy Commission). U. S. Patent 3,048,533. Aug. 7, 1962.

A cable connecting a control rod in a reactor with a motor outside the reactor for moving the rod, and a helical conduit in the reactor wall, through which the cable passes are described. The helical shape of the conduit prevents the escape of certain harmful radiations from the reactor. (AEC)

26576 CONTROL MEANS FOR NEUTRONIC REACTORS. Lewi Tonks (to U. S. Atomic Energy Commission). U. S. Patent 3,048,534. Aug. 7, 1962.

A control device surrounding the active portion of a nuclear reactor is described. The control device consists of a plurality of contiguous cylinders partly filled with a neutron absorbing material and partly filled with a neutron reflecting material, each cylinder having a longitudinal reentrant surface into which a portion of an adjacent cylinder extends, one of the cylinders having two re-entrant surfaces, and means for rotating the cylinders one at a time. (AEC)

26577 NON-CORROSIVE REACTOR FUEL SYSTEM. Claude C. Herrick (to U. S. Atomic Energy Commission). U. S. Patent 3,049,481. Aug. 14, 1962.

A non-corrosive nuclear reactor fuel system was developed utilizing a molten plutonium–iron alloy fuel having about 2 at. % carbon and contained in a tantalum vessel. This carbon reacts with the interior surface of the tantalum vessel to form a plutonium resistant self-healing tantalum carbide film. (AEC)

26578 NEUTRONIC REACTORS AND CONTROL MEANS THEREFOR. Kenneth A. Kesselring (to U. S. Atomic Energy Commission). U. S. Patent 3,049,483. Aug. 14, 1962.

A nuclear reactor comprising a cylindrical active portion, a fixed reflector around the active portion having equally spaced apertures therein parallel to the longitudinal axis of the active portion, and rotatable cylindrical bodies in each of these apertures including parallel neutron reflector portions and parallel neutron absorber portions are described. (AEC)

26579 SUPPORT STRUCTURE. John Tatlock and John Alexander Forbes Glass (to U. S. Atomic Energy Commission). U. S. Patent 3,049,485. Aug. 14, 1962.

The core support structure for fuel elements of a fast reactor is described. The support structure comprises a nest of tubes of alternately long and short length in longitudinally parallel relationship and arranged in a symmetrical hexagonal lattice. Each tube has a hexagonal section of flat contact faces disposed intermediate its ends and at points wherein tube pairs are engaged in face to face contact. One of each pair of adjacent tubes is slotted to receive the intersecting portion of the other tube of the pair, the intersecting portion bearing against the fuel element contained in the slotted tube for locating the element therein. (AEC)

26580 NUCLEAR REACTOR FUEL-BREEDER FUEL ELEMENT. Edwin L. Currier, Jr. and John H. Nicklas (to U. S. Atomic Energy Commission). U. S. Patent 3,049,486. Aug. 14, 1962.

A fuel-breeder fuel element was developed for a nuclear reactor wherein discrete particles of fissionable material are dispersed in a matrix of fertile breeder material. The fuel element combines the advantages of a dispersion type and a breeder-type. (AEC)

26581 DIRECT-CYCLE, BOILING-WATER NUCLEAR REACTOR. Joseph M. Harrer, Leonard W. Fromm, Jr., and Verne M. Kolba (to U. S. Atomic Energy Commission). U. S. Patent 3,049,487. Aug. 14, 1962.

A direct-cycle boiling-water nuclear reactor is described that employs a closed vessel and a plurality of fuel assemblies, each comprising an outer tube closed at its lower end, an inner tube, fuel rods in the space between the tubes and within the inner tube. A body of water lying within the pressure vessel and outside the fuel assemblies is converted to saturated steam, which enters each fuel assembly at the top and is converted to superheated steam in the fuel assembly while it is passing therethrough first downward through the space between the inner and outer tubes of the fuel assembly and then upward through the inner tube. (AEC)

Power Reactors

Refer also to abstract 25697.

26582 (ACNP-6112) PATHFINDER ATOMIC POWER PLANT. PROGRAM AND ORGANIZATION FOR PREOPERATIONAL AND NUCLEAR TESTING. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). [nd.] For Northern States Power Co., Minneapolis. Contract AT (11-1)-589. 68p.

Preoperational and initial startup programs are described. The purpose of the preoperational program including 8 tests is to demonstrate that plant components and equipment will function as specified and to demonstrate that the plant is ready for nuclear startup. The initial startup program consists of a series of tests to demonstrate the physics performance of the reactor and the performance of the integrated plant operation. Organization and training for the tests are discussed. (M.C.G.)

26583 (APAE-105(Suppl.1)) THERMAL ANALYSIS OF SM-1 CORE III. S. L. Davidson (Alco Products, Inc., Schenectady, N. Y.). June 29, 1962. Contract AT(30-1)-2639. 24p.

The thermal analysis performed on the SM-1 Core III for both steady state and transient conditions is reported. SM-1 Core III will be used as a test for Type 3 elements in a PM-2A Core. The steady state analysis indicated minimum departure from nucleate boiling ratios (DNBR) for both design and scram conditions above the minimum criteria of 1.5. Local nucleate boiling was noted in the hot internal channels and lattice passage at scram power conditions. Loss of flow transient results indicate DNBR's above 1.5, insuring that the core is safe from burnout. Bulk boiling was noted in the hot channels and lattice passage at scram power condition. (auth)

26584 (CEND-150(Pt.IV)) ADVANCED INDIRECT CYCLE WATER REACTOR STUDIES FOR MARITIME APPLICATIONS. PART IV. STEAM DRIVEN COOLANT PUMPS. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Oct. 23, 1961. Contract AT(30-1)-2709. 22p. (NYO-9949(Pt.IV))

A comparison is made of the relative merits of steam turbines and electric motors as drivers for maritime nuclear reactor coolant pumps. The comparison is made from both a technical viewpoint and an economic viewpoint. The two are almost equal from an economics standpoint with the turbines having a slight advantage for the particular application of the reference plant. There is a capital cost advantage to the steam driven pumps; but, because of the low efficiency of small turbines, the fuel costs are higher. The designer might select turbine drivers for a specific application for the purpose of adding reliability and flexibility to the operation of the plant. This might be done where non-propulsion steam demand of the plant was appreciable such as process heat for refrigeration or special heating loads. The turbine drives also add a safety feature to coolant circulation startup by permitting, without adding special features, a gradual increase in flow rate rather than a sudden one. (auth)

26585 (CVNA-95) THERMAL AND HYDRAULIC DESIGN OF THE CVTR PRESSURE TUBE. R. O. Sandberg, L. E. Efferding, and A. A. Bishop (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). June 1962. For Carolinas Virginia Nuclear Power Associates, Inc. Contract [AT(30-1)-2289]. 183p.

A review is given of the thermal and hydraulic design of the pressure tube employed in the CVTR, a heavy water cooled and moderated pressure tube thermal reactor. The pressure tube is U-shaped and operates at a nominal pressure of 1500 psi with a maximum pressure drop across the tube of 85 psi. Total flow through the 36 U-tubes of the reactor is 3.3×10^6 lb/hr and the initial gross power rating is 44.3 Mw. Nominal heat leakage to the moderator is 3.0 Mw. A cold tube concept is used; therefore, a multi-

layer vertical water insulating system is used inside the pressure tube. The thermal and hydraulic aspects of the development of the insulating system and seals which culminated in the final design are traced. Fixed orificing is used across selected pressure tubes. The effect of dimensional tolerances on the thermal performance is analyzed. A comparison is made of the hydrodynamic stability in U-tubes and through-tubes. (auth)

26586 (CVNA-108) DEVELOPMENT OF THE CVTR MODERATOR TANK. J. Godts, D. R. Thomas, and J. N. Elyson (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Aug. 1961. For Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). Contract [AT(30-1)-2289].

A development program is described to design a tank for CVTR which incorporates adequate provisions for moderator containment, moderator flow distribution, and support of the reactor's main components. A drawing of the final moderator tank configuration is included. Qualitative indications of flow patterns in a full-sized tank were obtained with a scale model. (J.R.D.)

26587 (CVNA-117(Vol.I)) A DIGITAL COMPUTER ANALYSIS OF LOSS-OF-COOLANT ACCIDENT FOR A MULTI-CIRCUIT CORE NUCLEAR POWER PLANT (ALPS CODE). Amir N. Nahavandi, William A. Webb, John D. Phillips, and William P. Kunkel (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1962. For Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C. Contract [AT(30-1)-2289]. 92p.

A mathematical analysis is presented concerning a loss-of-coolant accident in the primary system of a multi-circuit core nuclear power plant caused by a complete severance of a pressure or jumper tube. The problem is solved numerically on an IBM-7090 digital computer using the governing differential equations in finite difference form. The digital program, designated as "ALPS" Code, is used to determine the thermal and hydraulic behavior of the primary system after the occurrence of an instantaneous, completely parted rupture of a pressure or jumper tube in the reactor. The system mass flow rate, pressure and enthalpy distribution are calculated together with the other important system properties as functions of time during the transient operation following the break. The program is also used to determine the characteristics of the emergency injection system required to prevent core damage following the loss-of-coolant accident. (auth)

26588 (CVNA-117(Vol.II)) A DIGITAL COMPUTER ANALYSIS OF LOSS-OF-COOLANT ACCIDENT FOR A MULTI-CIRCUIT CORE NUCLEAR POWER PLANT (ALPS CODE). Amir N. Nahavandi, William A. Webb, John D. Phillips, and William P. Kunkel (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1962. For Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C. Contract [AT(30-1)-2289]. 153p.

Input data sheets, FORTRAN source program listing, and a sample of output data sheets are presented for an analysis of loss-of-coolant accident for a multi-circuit core nuclear power plant on the IBM 7090 computer. (M.C.G.)

26589 (CVNA-121) DEVELOPMENT OF CVTR CONTROL RODS AND DRIVE MECHANISMS. H. W. Keller, H. N. Andrews, N. R. Singleton, A. Selz, J. T. Haller, and C. Marti-Balaguer (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1962. For Carolinas Virginia Nuclear Power Associates, Inc., Columbia, S. C. Contract AT(30-1)-2289. 162p.

Several control rod drive system designs were studied for the CVTR plant. For the selected design, a prototype control rod drive line including a prototype control rod drive mechanism was built and evaluated in a test facility simulating reactor conditions. The system was subjected to environmental testing in excess of design life requirements. As testing progressed, modifications were incorporated in the prototype system to improve its performance. All components were evaluated for effectiveness and wear. Scram performance was analyzed. Drop tests to measure the effectiveness of the control rod stop in the event of a drive line failure were conducted. As a result of testing, improvements were incorporated in the design released for production. (auth)

26590 (DLCS-3960101) REACTOR PLANT CONTAINER AIR COOLING MODIFICATION TEST. CORE I, SEED 3. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, May 11, 1962. Contract [AT-11-1-GEN-14]. 29p.

Tests were carried out to determine the operating characteristics of the reactor plant container air cooling system at the design conditions of Core II operation and to determine whether the system meets its design specifications. The system operated satisfactorily during the performance of the test, maintaining the container average ambient temperature below the design temperature of 122°F. The boiler chamber air cooling units performed above their heat removal specification by 8.5%. The average heat removal rate of the reactor chamber air cooling units was below their specifications by 16%. (M.C.G.)

26591 (DLCS-4000301(Rev.)) AUTOMATIC DATA LOGGING AND COMPUTING SYSTEM CALIBRATION TEST. CORE I, SEED 3. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First issue, Mar. 8, 1962. Second issue, June 19, 1962. Contract [AT(11-1)-292]. 78p.

An automatic data logging and computing system was set up to record station operating parameters. A calibration curve for the instrument trains as read on the computer was obtained. The data acquisition proved to be effective in acquiring all types of reactor and turbine-generator plant data. The computer could accurately convert plant signals to meaningful engineering terms. The limits placed on data acquisition did not come from the computer but from either the transducer or the transmission of the signals. Noise and non-linearity caused the greatest deviations. Parameters met the requirements throughout their normal operating range. (M.C.G.)

26592 (GAMD-1722) DESIGN OBJECTIVES FOR THE MARITIME GAS-COOLED REACTOR LAND-BASED PROTOTYPE. J. D. Messersmith, W. C. Moore, and H. N. Wellhouser (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Oct. 6, 1960. Reprinted Mar. 29, 1962. Contract AT(04-3)-187. 39p.

Design criteria for a land-based prototype of the MGCR are discussed. It was ascertained that the BeO-moderated helium-cooled reactor had the most attractive possibilities. Power rating, cycle conditions, moderator, fuel, coolant, maneuvering requirements, core design, pressure vessel, control rods, shielding, turbine machinery, other propulsion system equipment, and auxiliary system equipment are described. (M.C.G.)

26593 (GAMD-3168) TNT, A PROGRAM FOR ANALYZING THE TRANSIENT PERFORMANCE OF THE PEACH BOTTOM HTGR FISSION PRODUCT TRAPPING SYSTEM. W. W. Graham, III (General Atomic Div. General Dynamics Corp., San Diego, Calif.). May 15, 1962. Contract AT(04-3)-314. 81p.

TNT is a digital computer program written in Fortran

for the IBM-7090 computer. The program was developed to analyze the steady-state and transient operational performance of the charcoal adsorber beds for the Peach Bottom HTGR Fission Product Trapping System. The primary purpose of the Fission Product Trapping System is to provide sufficient holdup of Kr and Xe to remove them by decay from the helium stream. The nature of the process renders it susceptible to changes in system pressure, helium flow rate, inlet temperature, and input activity as well as coolant failures and other accident conditions. TNT is useful in determining the extent of such susceptibility; results obtained in its use also suggest operational techniques which may be helpful in obtaining optimum performance. Steady-state and transient problem examples are given. (P.C.H.)

26594 (GNEC-74) INTERIM REFERENCE DESIGN GAS-COOLED, HEAVY-WATER-MODERATED PRESSURE-TUBE REACTOR PROTOTYPE (GCPTR). (General Nuclear Engineering Corp., Dunedin, Fla.). Sept. 5, 1958. For East Central Nuclear Group and Florida West Coast Nuclear Group, Inc., St. Petersburg, Fla. Contract [AT (38-1)-200]. 201p.

The design concepts of the gas-cooled, heavy-water-moderated, pressure-tube reactor are presented and discussed. The reactor power is 175 Mw thermal and 58 Mw electric, giving a net thermal efficiency of 33.2%. The prototype is designed so that it may be adaptable to a 200 Mw electric output plant that will use natural uranium as a fuel. The first fuel load of the prototype will use slightly-enriched uranium dioxide with stainless steel cladding. High thermal performance (heat rate of 10,300 Btu/kwh) is achieved by operating at a gas outlet temperature of at least 1000°F. Good neutron economy results from the use of heavy water as the moderator and the use of core and fuel materials of low neutron cross section. A single-pressure cycle uses a feedwater temperature of 256°F and produces steam at 1800 psi/1000°F with reheat to 1000°F. (N.W.R.)

26595 (GNEC-82) GAS-COOLED REACTOR PROJECT PROGRESS REPORT NO. 3. (General Nuclear Engineering Corp., Dunedin, Fla.). Jan. 7, 1959. For East Central Nuclear Group and Florida West Coast Nuclear Group, Inc., St. Petersburg, Fla. Contract AT(11-1)-795. 150p.

Progress on the design and development of a prototype gas-cooled, heavy-water-moderated, tube-type reactor is reported. Topics covered include engineering analysis, physics, materials, design of reactor components, fuel development program, and test facilities. (M.C.G.)

26596 (LAMS-2722) ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX). Quarterly Status Report for Period Ending, May 20, 1962. (Los Alamos Scientific Lab., N. Mex.). June 1962. Contract W-7405-Eng-36. 22p.

Calculations of the power profiles in the UHTREX core are tabulated for an assumed condition in which the total power is 3 Mw and the core temperature is isothermal at 1800°K. A discussion concerning alternate shutdown rod systems is presented. It is noted that the control rods in UHTREX are not symmetrical with respect to the central plane, but will bottom near the base of the core and extend some distance above the top of the core. Calculations reveal that the effect of this arrangement on reactivity is nonlinear with the depth of loaded annulus insertion. In other work, a mockup of the rod mechanism was constructed for cycle testing. Tests of the core support bearing are also reported along with fuel loader tests. Calculation results of steady state and transient heat transfer in the reactor core are presented graphically. A core flow model was designed for the cooling system development. Copper oxide and molecular sieve tests are reported in gas-cleanup system development. A tabulation of instrumentation and data system requirements is presented along with a discussion of various auxiliary channels. Materials studies are being conducted in a high-temperature He loop. (J.R.D.)

26597 (NAA-SR-6585) CONTROL ROD CALIBRATIONS FOR THE SRE WITH THORIUM–URANIUM FUEL. R. W. Keaten and R. A. Lewis (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). June 1, 1962. Contract AT(11-1)-Gen-8. 29p.

Shim and safety rods of the Sodium Reactor Experiment were calibrated for the second core loading of thorium-uranium fuel clusters. One shim rod was differentially calibrated by period measurements, using two different configurations of the other rods to permit an estimation of the shadowing effect between rods. The other rods were then calibrated by comparing them to this rod. Results showed that the average rod worth had increased about 14% of the rod worth above that in the first core. A calculation gave results in good agreement, and showed that the increase was caused by an increase in the thermal diffusion area. The total measured worth of the control system was $22.0 ± 0.7, but analysis indicated that shadowing between rods reduced this to $17 ± 2. The shutdown margin with the operational loading was thus $12 ± 2. Calculations showed that loss of shim rod worth due to burnup was less than 20¢ for the combined first and second core operation. Complete burnup would require over 100,000 Mwd. However, the rods must be recalibrated every 2000 Mwd because the change in critical configuration due to fuel burnup causes a change in the calibration curves. Subsidiary measurements showed that the theoretical waiting times of B. J. Toppel were accurate, and that use of O. Riedel's statistical method permitted a precision of 1% in the period measurements. (auth)

26598 (NAA-SR-7144) THERMIONIC CONVERTERS FOR COMPACT NUCLEAR POWER PLANTS. N. S. Rasor and C. C. Weeks (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1962. Contract AT(11-1)-Gen-8. 92p.

A brief review of several thermionic nuclear power plants leads to the conclusion that the in-core concept is the most practical and useful system for space applications. Fundamental considerations indicate that emitter temperatures from 1500 to 1900°C are required for this concept, and that the high work function refractory metals are the best electrode materials for achieving the required performance and lifetime at these temperatures. The analytical and experimental technology developed for systematically defining the optimum materials and operating conditions is described, along with the significance of the experimental results obtained. These results have shown that the required performance can be obtained with the elementary cesium vapor diode converter. It was also shown that impurities cause pronounced effects on both performance and lifetime, and that their suppression or controlled utilization is an important aspect of the present approach. (auth)

26599 (WAPD-PWR-TE-79) FISSION PRODUCT ACTIVITY LEVELS IN THE PRIMARY COOLANT OF PWR DURING CORE 1 SEED 1. P. W. Frank (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1960. Revised Apr. 1962. Contract [AT(11-1)-Gen-14]. 19p.

The levels and distribution of fission products in the coolant of the Shippingport Pressurized Water Reactor were

evaluated for the entire period of Seed 1. Recoil escape, defected UO_2 rods, and effect of pH on the deposition of alkaline earth fission products are discussed. The specific activities of all soluble fission products in the reactor coolant except Kr^{85m} and Kr^{87} showed an increase during operation. (M.C.G.)

26600 (WCAP-4126) CVTR PROJECT, CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. MONTHLY PROGRESS REPORT, JUNE 1962. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 13p.

Progress on the CVTR project is reported. Topics covered include: project administration, nuclear design, pressure tube assembly development and analysis, fuel development, irradiation experiments and analysis, materials development and fabrication techniques, plant system development, instrumentation and control, safety analysis and evaluation, critical experiment, and post construction research and development. (M.C.G.)

26601 (AEC-tr-5078) INVESTIGATION ON STABILITY OF A BOILING HEAVY WATER REACTOR. Hiroshi Nishihara and Hideaki Nishihara. Translated from Nippon Genshiryoku Gakkaishi, 2: 451-9(1960). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 25022.

26602 (AEC-tr-5164) POWER REACTOR OPERATED WITH URANIUM HEXAFLUORIDE. Hermann Clasen. Translation of German Patent Application. Jan. 18, 1962. 5p.

A power reactor concept is described in which the reaction zone consists of a turbine to be driven by UF_6. Compressed UF_6 is admitted to an expansion turbine consisting largely of beryllium. A continuous chain reaction takes place in the turbine if it is adequately large and the UF_6 used has a satisfactory density. A thermal engine with an optimum thermal efficiency is obtained by using the reactor turbine, a connected turbine for adiabatic expansion, and two additional turbocompressors for recompression. (M.C.G.)

26603 (EURAEC-36) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD NOVEMBER 1, 1959 TO JANUARY 31, 1960. PART A. TECHNICAL REPORT. Quarterly Report No. 1. Centro Informazioni Studi Esperienze, Milan). Feb. 15, 1960. Work performed under United States–Euratom Joint Research and Development Program. 42p. A Translation of CISE-R-18.

The program for evaluating steam-water mixtures as coolants for light water moderated power reactors is presented. The program is designed to obtain data on burnout, heat transfer, and pressure drop mechanisms in fog flow at medium and high pressures. A study of flow stability in fuel channels and corrosion of fuel element cladding is also planned. (J.R.D.)

26604 (EURAEC-38) CAN–1 QUARTERLY PROGRESS REPORT FOR THE PERIOD MAY 1, 1960 TO JULY 31, 1960. Quarterly Report No. 3. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Aug. 31, 1960. Work Performed under United States–Euratom Joint Research and Development Program. Contract 002-59-11RDI. 21p. Translation of CISE-R-24.

Work was devoted mainly to operation of the heat transfer and flow stability loops. Heat transfer data are included. Various modifications made during operation of the flow stability loop are reported. (J.R.D.)

26605 (FTD-TT-61-241) THERMAL POWER ENGINEERING FOR NUCLEAR INSTALLATIONS. B. V. Petunin. Translation of "Teploenergetika Yadernykh Ustanovok" (a publication of the State Committee for the Utilization of Atomic Energy of the Council of Ministers, Moscow, 1960).

Thermal power engineering for nuclear power plants is discussed. Topics covered include: elementary information on reactors, heat carriers, thermal power systems for nuclear plants with steam water cycles, thermal power systems for nuclear installations with gas-turbine cycles, and heat exchange equipment. (M.C.G.)

26606 BRITISH COMMERCIAL NUCLEAR POWER TODAY. A. L. Shaw. AEI (Assoc. Elec. Ind.) Eng., 1: 140-6(Apr. 1961).

A summary of the economic aspects of Calder Hall (Magnox) type reactors, the Windscale AGR, and the High Temperature Gas Cooled Reactor is given. Generation costs are studied, with attention to operation and maintenance, fuel consumption, fuel investment, and capital costs. Generating costs of coal and nuclear power stations are compared. Particular attention is given to geographic factors influencing generating costs. (T.F.H.)

26607 MAGNOX REACTOR OPTIMIZATION OVER A RANGE OF OUTPUTS. R. E. Strickland (Imperial Coll. of Science and Tech., London). Nuclear Eng., 7: 265-7 (July 1962).

The capital and generating costs for a natural-U-fueled, graphite-moderated reactor (e.g., one of the Calder Hall type) are studied as functions of the reactor configuration and output (0 to 300 Mw). Particular attention is given to values that express the rate at which specific costs of special items increase with decreasing reactor output. It is shown that design optimization of reactors with outputs lower than about 50 Mw can lead to much lower costs for these units than are predicted by extrapolations of data from higher power reactors. (T.F.H.)

26608 ELECTRICAL FEATURES OF THE ELK RIVER REACTOR PLANT. D. C. McClintock (Sargent and Lundy Engineers, Chicago). Power App. Systems, No. 59, 41-7 (Apr. 1962).

Attention is given to the Elk River Power Reactor and its plant layout and electrical system. The electrical components studied are those that produce commercial power, those that handle the operation of the reactor, and those that comprise control and instrumentation facilities for the reactor. The design and installation of the electric system generally follows that of a conventional plant. Many of the innovations described consist of conventional, standard manufactured items used in unconventional applications. (T.F.H.)

26609 PLUTONIUM IN NUCLEAR POWER DEVELOPMENT. O. D. Kazachkovskii and V. B. Lytkin. Vestnik Akad. Nauk S.S.S.R., 32: No. 6, 41-9(June 1962). (In Russian)

A review is given of the properties, abundance, and applications of plutonium in fuel systems of fast breeder power reactors. (R.V.J.)

26610 FUEL ELEMENTS FOR POWER REACTORS. (United Kingdom Atomic Energy Authority, London). Mar. 1962. 22p. Free (BIS).

Experience of the United Kingdom Atomic Energy Authority in the development, testing, and manufacture of natural uranium fuel elements is described. The scale on which these fuel elements are being manufactured for use in the British nuclear power program is indicated. Emphasis is placed on irradiation testing. (M.C.G.)

26611 IMPROVEMENTS IN NUCLEAR REACTOR HEAT GENERATING AND UTILIZING PLANT. Anthony James Taylor (to Babcock and Wilcox Ltd.). British Patent 902,182. July 25, 1962.

A nuclear power plant with a gas-cooled reactor is designed in which variations of the coolant temperature at the reactor inlet are reduced. The reducing means is a by-pass duct disposed in a space within the heat exchanger pressure vessel for bypassing coolant around the heat exchanger. (D.L.C.)

Production Reactors

26612 (HW-73643) TRUARC RETAINING RING FAILURE INVESTIGATION. R. M. DuPerre (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 15, 1962. Contract AT(45-1)-1350. 41p.

An investigation was made to establish the mechanism of failure of Truarc rings used to retain the inlet and outlet nozzle assemblies of the 100-K reactors and to determine suitable courses of corrective action. Approximately 75% of the nozzle flange plate retaining rings presently installed on the front face of the K Reactors have at least one radial crack which will allow a complete separation of the ring. Although oxidized and pitted, approximately 93% of the original thickness of the ring remains. The retaining capacity of the ring and groove as designed is limited by the strength of the groove. In short-term tests of load capacity, the rings were deformed but intact after the grooves had failed. An analysis of rings that had cracked in service indicated that the rings had absorbed a large amount of hydrogen, and that failure was due to hydrogen-induced static fatigue. Proposed modifications to design are outlined. (M.C.G.)

26613 (NDA-2164-3) AN EVALUATION OF U^{233}–THORIUM FAST BREEDER POWER REACTORS. R. Hankel, L. Joseph, J. Bobker, A. Goldman, R. Hanfling, H. Krug, and M. Stuart (United Nuclear Corp. Development Div., White Plains, N. Y.). Apr. 15, 1962. Contracts AT(30-1)-2303 and AT(30-1)-2830. 275p.

A study of fast U^{233}-Th breeders was performed. Comparative evaluation of potential fuels for fast U^{233}-Th^{232} breeders resulted in the selection of carbide fuel based on minimum fuel costs and attractive doubling time. A reference design of a 300 MW_e carbide-fueled reactor plant yielded an energy cost of 9.1 mill/kwh for a fuel burnup of 50,000 MW-d/tonne. At equilibrium fuel cycle conditions, the reference design has a breeding ratio of 1.31 and a total inventory doubling time of 23 yr. Unique characteristics of U^{233}-Th fueled fast breeders such as continued buildup of reactivity after shutdown, the requirement for remote handling of fresh fuel, and the low delayed neutron fraction, were considered. It was concluded that these characteristics can be accommodated by appropriate design features without appreciably affecting either power generation cost or safety of operation. A comparison of the reference carbide-fueled design with a plutonium oxide-fueled fast breeder indicated comparable power generation costs and doubling times. In comparison with U^{235}-fueled, thermal homogeneous breeders, the fast U^{233} breeder offers lower power generation cost (9.1 as against 10.6 mill/kwh for the thermal breeder) but longer doubling time (23 yr as against 6 to 20 yr for the thermal breeder). (auth)

Research Reactors

Refer also to abstract 25166.

26614 (AECL-1486) CONTROL AND SAFETY IN THE OPERATION OF THE NRX AND NRU REACTORS. D. G. Breckon and J. J. Collins (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1962. 41p.

Presented at International Atomic Energy Agency Symposium on Reactor Safety and Hazards Evaluation Techniques, Vienna, May 14–18, 1962.

Safety in reactor operations is achieved through review and development of reactor control systems together with the exercise of sound administration controls. At Chalk River, the control and safety systems of the NRX reactor were developed over the 14-year history of the reactor to provide safer and more reliable operation. The original 18 boron carbide shut-off rods were replaced by 6 electrically operated rods of greater reliability. To augment this change an automatic dump of the heavy water moderator was included. Both devices function simultaneously but each is capable of shutting down the reactor independently. Control of reactor power was initially maintained through two manually operated devices; a cadmium control rod and an overflow weir by which the moderator level was adjusted. Later, automatic control of the cadmium rod was possible during power operation. Now, automatic start-up and power control is achieved by adjustment of the moderator level, eliminating the control rod and the weir. Incorporation of a two out of three coincidence system further improved the safety of the reactor. To assist in training, manuals and policy instructions are used. These form the basis for the operation and are augmented by the control procedures. Field work is controlled by work permits, entry to limited access areas through interlock systems and operation of valves through valve slips and flowsheets. Where feasible check-off systems are used to verify field operations. Scheduled checks made possible at power by the two out of three coincidence system permit a continual assessment of the reactor systems. When associated with well established maintenance procedures, they enhance the reliability and safety of the reactor. (auth)

26615 (CEA-2134) DISPOSITIF D'IRRADIATION SOUS CHAMP MAGNETIQUE EN PILE PISCINE, A HAUTE OU BASSE TEMPERATURE. (Apparatus for Irradiating in a Magnetic Field in a Swimming-Pool Type Reactor, at High or Low Temperatures). J. Pauleve (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). 1962. 12p.

An apparatus for irradiation in a swimming-pool with a magnetic field of 5000 oersteds is described. An Al coil with a very high current density is water cooled. A relatively great volume can be used in the coil center, and two furnaces can be introduced, or a liquid N cryostat. (auth)

26616 (HW-73755) HEAVY WATER LOSSES IN THE PRTR. H. Harty, K. G. Toyoda, and R. D. Widrig (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1962. Contract AT(45-1)-1350. 45p.

During initial power operation from July through November of 1961, D_2O loss rates from the PRTR were reduced from over 200 lb/day to about 40 to 50 lb/day. No single source could be identified as a major contributor to the heavy water losses. However, the initial collection rates from the D_2O recovery system compared to later collection rates, and the magnitude of the helium losses (which may be laden with D_2O) make these systems prime suspects. The ventilation exhaust air from the containment vessel was identified as the principal avenue of escape for the D_2O. During the latter portion of the reporting period, it was determined by various detection techniques that D_2O losses were occurring from three locations in about the following amounts: instrument cells—15 lb/day, D_2O recovery system—15 lb/day and process cell—20 lb/day. Of the total of 50 lb/day, tritium analyses of condensate samples showed that D_2O losses from the moderator and reflector

systems were about 15 lb/day, with the remainder being lost from the primary system. The rate of loss from the moderator and reflector systems appeared to be similar for both reactor operation and shutdown. While D_2O losses during shutdown were generally less than during reactor operation, periods of high losses (up to about 5 to 10 lb/hr) occurred during fuel charging operations and D_2O spills. It is believed that the D_2O loss design goal of about 20 lb/day during operation can be achieved. The absence of large leaks makes it necessary to routinely monitor potential leak points and to replace or modify those pieces of equipment with chronic leakage histories. (auth)

26617 (JEN-97-DF/I-30) DESCRIPCION GENERAL DEL REACTOR JEN-1. (General Description of JEN-1 Reactor). M. Enriquez de Salamanca (Spain. Junta de Energia Nuclear, Madrid). 1961. 43p.

A description of the 3-Mw JEN-1 swimming pool-type reactor is given along with the auxiliary equipment, installations, and buildings. The fuel elements are of the MTR type (flat plates and 20% enrichment). Boral sheets are used as control elements. Results are presented of measurements made with the reactor. (auth)

26618 (ORNL-TM-173) SUMMARY OF HRT RUN 25. J. R. Engel, H. F. Bauman, J. R. Buchanan, P. N. Haubenreich, H. B. Piper, and D. M. Richardson (Oak Ridge National Lab., Tenn.). July 25, 1962. Contract W-7405-Eng-26. 48p.

Run 25 was the final period of power operation of the HRT. The reactor was operated for periods of 62, 8, 52, and 80 hours at 5 Mw with no outward indication of fuel solution instability at a system pressure of 1400 psig and core and blanket average temperatures of 270 and 230°C, respectively. The uranium concentration in the blanket was 1.7 to 2.0 g U/kg D_2O. Longer periods of operation were prevented by mechanical difficulties, notably with the fuel feed pump. While the reactor was subcritical after the last of the above runs, the upper patch in the core-tank wall became dislodged, allowing greater core-to-blanket mixing. The resultant blanket uranium concentration was 2.9 g U/kg D_2O. The reactor was subsequently operated at pressures of 1250, 1400, and 1700 psig with blanket temperatures of 230 and 240°C. Fuel instability was apparent at all conditions at 5 Mw. The reactor was shut down on April 28, 1961. The experiment was operated at high temperature for a total of 10,866 hours. The system was critical for a total of 8,841 hours and produced 16,295 Mw-hours of power. The fuel, heavy water, and some corrosion specimens were recovered, and the reactor was stored in an assembled state. (auth)

26619 (ORNL-TM-203(Add.)) MURGATROYD--AN IBM 7090 PROGRAM FOR THE ANALYSIS OF THE KINETICS OF THE MSRE. C. W. Nestor, Jr. (Oak Ridge National Lab., Tenn.). May 25, 1962. Contract [W-7405-eng-26]. 3p.

An addition is presented for the IBM-7090 program MURGATROYD to produce a rough graph of reactor power versus time. A sample of output is included for the case given as an example. (J.R.D.)

26620 (ORNL-TM-277) FUEL CYCLES AND LOADING PROGRAMMING FOR WATER-COOLED RESEARCH REACTORS. A. L. Colomb and D. Cavin (Oak Ridge National Lab., Tenn.). July 31, 1962. Contract W-7405-eng-26. 31p.

The problems encountered while developing loading methods for the ORNL water-cooled research reactors are discussed. The methods used to program the fuel loading for the LITR and ORR are described as well as the experimental methods that produced the data necessary for the solution of these problems. (auth)

26621 THE PRESENT STATUS OF RESEARCH REACTORS. K. Fritz (International Atomic Energy Agency, Vienna). Atompraxis, 8: 197-203(June 1962). (In German)

The swimming pool reactor, the tank type, Argonaut, Triga, the water boiler, the heavy water reactor, and the graphite reactor are discussed. Characteristics of each type are outlined giving the status and outlook of technical development. Research facilities of the reactors and possibilities for which each type is best suited are also discussed. A table is given showing the reactor types used in different countries. (auth)

26622 SILOE, A NEW RESEARCH REACTOR IN THE GRENOBLE NUCLEAR RESEARCH CENTER. M. Denielou (Commissariat à l'Énergie Atomique, Paris). Atompraxis, 8: 203-8(June 1962). (In French)

Melusine and the development of Siloe are surveyed, and the reasons governing the choice of this type of reactor and questions of installed output, reactor geometry, details of the core, and control measures are discussed. Experimental plans are indicated. (auth)

26623 WORK WITH THE RESEARCH REACTOR ASTRA. A. Burtscher, A Nedelik, G. Quittner, L. Balcarczyk, H. Bildstein, and G. Stehlik. Atompraxis, 8: 208-12(June 1962). (In German)

Output experiments, experiments at low output, flow distribution in the fuel elements, examination of a divided core arrangement, and measurements of excess reactivity are described. Experience with radiation protection is reported. Measurements using neutron spectrometer, measurements of activation cross sections, production of radionuclides, neutron activation analysis, studies based on activation experiments in the field of solid state physics, research in radiochemistry, trace analysis of biological materials, and studies of the germinating power of wheat seed irradiated with neutrons are discussed. (auth)

26624 EXPERIMENTAL WORK WITH FRENCH RESEARCH REACTORS. P. Delattre (Commissariat à l'Énergie Atomique, Paris). Atompraxis, 8: 212-18(June 1962). (In French)

Experimental work with research reactors presents many organizational and technical problems. Some of the methods developed and employed in France to meet these problems are reviewed. (auth)

26625 THE MOST IMPORTANT EXPERIMENTAL FACILITIES OF THE AVOGADRO RSI REACTOR. A. Ascari, M. Domenici, and F. Pieragostini (Aus der Ferma Sorin, Saluggia Vercelli, Italy). Atompraxis, 8: 218-23 (June 1962). (In German)

A qualitative description is given of three experimental facilities of the Avogadro RSI reactor built by Sorin. These facilities are designed for screening experiments, for studying irradiation effects in metals, and for structure research. (auth)

26626 OPERATIONAL EXPERIENCE WITH REACTORS EL 2 AND EL 3. H. R. Mabeix and C. Candiotti (Commissariat à l'Énergie Atomique, Paris). Atompraxis, 8: 223-32(June 1962). (In French)

Technological and physical data are listed. Serious breakdowns and operational disturbances are analyzed and their causes discussed. (auth)

SPACE APPLICATIONS AND TECHNOLOGY

26627 (ASD-TR-61-201) EFFECTS OF OUTER-SPACE ENVIRONMENT IMPORTANT TO SIMULATION OF SPACE VEHICLES. Eugene M. Hart (Cornell Aeronautical Lab., Inc., Buffalo). Aug. 1961. Contract AF33(616)-6858. 116p. (AD-269014)

The results of a literature survey to define the effects of the outer-space environment important to the simulation of space vehicles are presented. The discussion is general, having not been constrained by the inclusion of specific vehicles or trajectories. Only the natural environment of space is considered and the survey is limited to the solar system with particular emphasis on the region in the near vicinity of the earth-moon system and at heights greater than 80 kilometers above the earth's surface. To specify those effects that need to be incorporated into a space training simulator, the exterior environment, its effects on the vehicle and crew, and the malfunctions that may result must be determined. These subjects are treated, along with a consideration of the adequacy of the existing data in the study. Recommendations for further study are presented. (auth)

26628 (JPL-TR-32-231) A NUCLEAR-ELECTRIC SPACEBUS FOR PLANETARY LANDING MISSIONS. Robert J. Beale and Evelyn W. Speiser (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May 1, 1962. Contract NAS 7-100. 16p.

A discussion is presented concerning the capabilities of a nominal 300-kwe nuclear-electric-powered spacebus having a gross weight of 16,000 lb to perform significant planetary landing missions to the inner planets. Representative missions which are considered include the delivery of landing capsules to the planets Mars, Venus, and Mercury. A description of a typical spacebus is presented including a list of possible scientific experiments for both the spacebus and landing capsule. A brief résumé of the spacebus operation and summary of the major subsystem weights are also shown. (J.R.D.)

26629 (NP-11728) SPACE ELECTRIC POWER SYSTEMS STUDY. Second Quarterly Progress Report, February 8, 1962 to May 8, 1962. F. X. Dobler, C. L. Doughman, R. C. Fear, G. E. Gerecke, M. A. Geyer, L. L. Hire, D. E. Krummel, J. W. Ogden, D. D. Pollard, W. A. Shilling, O. G. Smith, F. C. Stump, E. F. Swiderski, and L. L. Tipton (Westinghouse Electric Corp. Aerospace Electrical Div., Lima, Ohio). Contract NAS-1234. 271p.

Activities are described in a study program to develop parametric data for generation, control, conversion, and transmission of electric power for space vehicles. The coolant temperature considered for the generator is 500 to 1500°F, the voltage levels are 5000 to 50,000 d-c, and the ratings are 1 to 10 Mw. Research during the period revealed that the rectifier efficiency of the Si-diode systems is higher than the gas-tube diode system in the desired power range. The Si-diode system is also lighter. In comparison with the Si-rectification system, the gas-tube rectifier system offers higher allowable coolant temperature range in exchange for higher required weight, volume, and coolant flow. (J.R.D.)

26630 (NP-11861) HYPER-TEMPERATURE SENSORS FOR NUCLEAR ROCKET REACTORS. P. E. Brown (Radio Corp. of America. Aerospace Communications and Controls Div., Camden, N. J.). 1962. 29p.

The development of high-temperature neutron and temperature sensors for use in the core of reactors to provide direct information on transient conditions and to detect local excursions is described. The properties of SiC vs C thermocouples for in-core measurements are discussed. Size and weight of the sensors along with their location and connections are described. The measuring system is also discussed. (M.C.G.)

26631 (RM-2825-PR) SOLAR-FLARE RADIATION AND MANNED SPACE FLIGHT. D. J. Dugas (RAND Corp., Santa Monica, Calif.). Nov. 1961. Contract AF49(638)-700. 27p. (AD-269113)

Solar-flare emission will be the determining factor in shield design for manned interplanetary vehicles. Present knowledge of solar-flare characteristics is insufficient to permit an accurate calculation of the radiation dosage to be expected in space. Flares occur at irregular intervals, making them difficult to forecast; furthermore, the intensity and duration vary from one event to another in an undefined manner. This memorandum summarizes the currently known facts about solar flares, illustrates some of the difficulties in accurately determining shield requirements, and points out the areas in which additional experimental data would be of greatest value. (auth)

26632 (UCRL-6304) THE TORY II-A REACTOR: METHODS AND RESULTS OF NEUTRONIC MACHINE CALCULATIONS. V. E. Hampel and E. Goldberg (California. Univ., Livermore. Lawrence Radiation Lab.). May 1, 1962. Contract W-7405-eng-48. 39p.

The nuclear fuel mass and distribution of the Tory II-A reactor was established by extensive use of two multigroup diffusion codes. Basic critical assembly experiments provided a means of judging the validity of the nuclear cross sections and techniques employed. Critical experiments at room temperature on Tory II-A showed a deviation of 10% from the predicted radial power density at the core edge. Current calculations give a reactivity 3% higher than that found experimentally. The specific neutronic requirements are stated. After the general dimension of the reactor had become frozen from considerations of pertinent thermodynamic parameters, the critical fuel loading and its relative distribution in space had to be determined. Radial loading of fuel was varied in the computation to achieve constant radial power density within the core. Loading selections were made to maintain the power per tube within 5% of the ideal value. Machine calculations were performed on two 18-group diffusion codes, the one-dimensional ZOOM code and its two-dimensional ANGIE companion code. Confirmations of cross sections and the calculational methods were performed through normalization toward simple critical experiments which could be represented by the codes, exactly. Temperature effects for BeO-moderated systems were experimentally evaluated up to 1200°F. (auth)

26633 ADVANCED PROPULSION SYSTEMS CHALLENGE TODAY'S MATERIALS. Metal Progr. 82: No. 2, 107-10(Aug. 1962).

Materials problems in ion and plasma propulsion systems for space applications are discussed. Methods of producing the porous ionizer for ion propulsion systems are described. Materials being considered for nozzles include: W, Mo, HfB_4, TaB_4, TaC, and graphite. Properties of the following materials for use as electric insulators are discussed: HfC, BeO, and BN_3. (M.C.G.)

WASTE DISPOSAL AND PROCESSING

26634 (CEA-2130) ETAT DES ETUDES SUR LA VITRIFICATION DES SOLUTIONS CONCENTREES DE PRODUITS DE FISSION. (The Present State of Research on the Vitrification of Concentrated Solutions of Fission Products). R. Bonniaud and C. Sombret (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 21p.

Various glass compositions were studied by an active cell which forms glasses in crucibles. The leaching rate from the glass increases from one to two $\times 10^{-7}$ g of glass/cm^2/day. Activity loss by volatility during vitrification is usually below 0.1% of total activity. Off-gas cleaning is made easier by a filter of granules including iron. After saturation the filter content is melted. The calcination and vitrification plant discussed can treat 72 liters of solution containing tracer activity every day. A modification was made to reduce the loss of ruthenium-106. A pot vitrification plant is also being studied in order to reduce processing cost by pouring the glass after melting. A plant is also being studied for producing very active glass. (auth)

26635 (EIR-24) THE METHODS AND EQUIPMENT FOR THE TREATMENT OF LIQUID WASTE IN THE HOT LABORATORY AT WÜRENLINGEN (SWITZERLAND). P. Baertschi, P. Graf, H. R. von Gunten, and E. von Ruethi (Switzerland. Eidgenössisches Institut für Reaktorforschung, Würenlingen). May 1962. 22p.

The treatment plant for low-activity waste (combined calcium phosphate-iron hydroxide fluocculation/vermiculite ion exchanger) and the installation for the decontamination of medium level waste (ion-exchange-distillation) at the reactor center at Würenlingen, Switzerland, are described. Results of the laboratory experiments for the design of the radioactive water treatment systems are given. (auth)

26636 (EURAEC-84) WASTE DISPOSAL SERVICE. Quarterly Report No. 3, October–December 1960. (Brussels. Centre de Etude de l'Energie Nucleaire). Work performed under United States–Euratom Joint Research and Development Program. 18p.

Progress is reported on the construction of an incinerator for radioactive wastes. The efficiency of various filters for the removal of radioactive iodine was investigated. A study on the fixation of radioactive sludge by mixing with tar was continued. Data are included from a series of incorporation and elution tests. Methods for the fixation of radioactive sludge by mixing with vitrifying agents, methods for the disposal of radioactive wastes in the ground, the possibility of using S^{35} as a tracer for ground water flow, and the migration of radionuclides in soil were investigated. (C.H.)

26637 (HW-64292) DISPOSAL OF RADIOACTIVE LIQUID WASTES FROM 300 AREA LABORATORY FACILITIES. W. A. Haney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 14, 1960. Contract AT(45-1)-1350. 10p.

The functions and methods of operation of waste systems are reviewed. The wastes are characterized with respect to their chemical and physical properties. Inadequacies in the system are pointed out and solutions recommended. (M.C.G.)

26638 (HW-71627) THE DECONTAMINATION OF CONDENSATE WASTES CONTAINING AMMONIA. B. W. Mercer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 12, 1962. Contract AT(45-1)-1350. 17p.

Several cation exchange materials were investigated for their ability to remove trace strontium and cesium from dilute ammonium and hydrogen ion solutions. Amberlite IR-120 was found to have the highest uptake of strontium and clinoptilolite the highest uptake of cesium. Decalso was effective for removing both strontium and cesium from neutral ammonium ion solutions. Acidifying an actual condensate waste containing ammonia increased the uptake of strontium, whereas acidifying a pure ammonia solution decreased the uptake of strontium. A column of Amberlite IR-120 removed trace strontium from over 20000 column volumes of the actual condensate at pH 3 without reaching breakthrough. (auth)

26639 (HW-73412) RESEARCH AND DEVELOPMENT ACTIVITIES— FIXATION OF RADIOACTIVE RESIDUES, QUARTERLY PROGRESS REPORT, JANUARY–MARCH, 1962. E. R. Irish, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1962. Contract AT(45-1)-1350. 50p.

Research and development activities were continued in studies of the radiant-heat spray calciner mock-up system for the fixation of radioactive residues. Sorption studies using natural minerals, synthetic inorganic Zeolites, and resins were continued to explore the feasibility of sorption processes for the fixation of radioactive wastes. Results are also reported on the extraction of a number of specific radionuclides by ion exchange and solvent extraction as a step in high-level waste treatment and fixation. (C.H.)

26640 (ORNL-TM-259) THE CONTROL OF POT CALCINER TEMPERATURES TO ENSURE CALCINATION AT 900°C. J. M. Holmes (Oak Ridge National Lab., Tenn.). May 31, 1962. Contract [W-7405-eng-26]. 20p.

A program will be required for controlling the wall temperature of a pot calciner during calcination in order to prevent an excessive temperature rise from internal heat generation while assuring complete calcination of the cake at 1650°F. A linear approximation to a pot wall temperature program indicates that this can be accomplished by holding the wall temperature at 1650° for 0.8 to 1.0 hrs and then cooling the wall at rates dependent upon the cake internal heat generation rate and average thermal conductivity. A similar study indicates that if it is necessary to reheat the cake for complete calcination, the wall heating time must be limited to prevent excessive temperature rise in the cake. Reheating times are also dependent upon the cake internal heat generation and thermal conductivity. (auth)

26641 (TID-15431) STUDY OF DESIGN REQUIREMENTS FOR SEA DISPOSAL CONTAINERS. Final Report. Jack R. Pohlman and Andrew G. Pickett (Southwest Research Inst., San Antonio). Apr. 6, 1962. Contract AT(30-1)-2647. 62p.

Test results and information on the current techniques in sea disposal operations were reviewed and considered in establishing design requirements for containers used in sea disposal. In addition, all existing regulations and requirements of the authorities controlling fabrication, handling, transporting, and disposal of radioactive waste containers are cited. Discussions and recommendations on Portland Cement Concrete as a construction material for radioactive waste packaging, fabrication of reinforced concrete structures for packaging radioactive wastes, concrete thickness design, waste placement and compaction, vents, impact, and radioactive waste containers in current use for sea disposal operations are given. (auth)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

A

ADVANCED METALS RESEARCH CORP., SOMERVILLE, MASS.
Identification of stratospheric aerosols, 16: 25609 (AFCRL-62-299)
AEROJET-GENERAL NUCLEONICS, SAN RAMON, CALIF.
Fission gases from defective sheathed ceramic fuel elements, 16: 26485 (TID-7622(p.160-70))
Prog. rpt. on Rb corrosion, 16: 25712 (AGN-8051)
AERONAUTICAL SYSTEMS DIV., WRIGHT-PATTERSON AFB, OHIO.
Growth and analysis of Al_2O_3 "whiskers," 16: 25694 (ASD-TDR-62-272)
AERONAUTICAL SYSTEMS DIV. PHYSICS LAB., WRIGHT-PATTERSON AFB, OHIO.
Radiation chemistry of pentane isomers, 16: 25421 (WADD-TR-61-38)
Superconductivity and superconducting electromagnets, 16: 25881 (ASD-TN-61-160)
AEROPROJECTS, INC., WEST CHESTER, PENNA.
Prog. rpt. on ultrasonic cleaning of OMR fuels, 16: 25700 (NYO-10282)
AEROSPACE CORP., EL SEGUNDO, CALIF.
Thermal effects on plasma dispersion, 16: 26398 (AD-270033)
AIR FORCE CAMBRIDGE RESEARCH LABS. GEOPHYSICS RESEARCH DIRECTORATE, BEDFORD, MASS.
Chromospheric striation obscuration by great flare, 16: 26046 (AFCRL-834)
Green Glow diffusion program, 16: 25612 (HW-71400(Vol.I))
AKADEMIYA NAUK S.S.S.R.
Diffraction formation of particles at high energies, 16: 26089 (NP-11832)
Linear equations of dispersion method with two-particle approximation, 16: 26085 (NP-11632)
Metallochemistry and its problems, 16: 25702 (AEC-tr-5182)
Obtaining intense beam of polarized thermal neutrons, 16: 26198 (NP-11859)
Rapidly variable processes in plasma, 16: 26406 (NP-tr-883)
AKTIEBOLAGET ATOMENERGI, STOCKHOLM.
Half-lives of He-6, N-16, O-19, F-20, Al-28, Se-77m, and Ag-110, 16: 26213 (AE-78)
ALCO PRODUCTS, INC., SCHENECTADY, N. Y.
Analysis of Spert-III critical experiments, 16: 26456 (APAE-MEMO-279)
Fission product levels in SM-1 coolant, 16: 26490 (TID-7622(p.236-42))
Thermal analysis of SM-1 Core III, 16: 26583 (APAE-105(Suppl.1))
ALLEGHENY LUDLUM STEEL CORP., BRACKENRIDGE, PENNA.
Prog. rpt. on Mo alloy extrusion, 16: 25729 (ASD-TR-7-785(VI))
ALLIS-CHALMERS MFG. CO., MILWAUKEE.
Preoperational and nuclear testing of Pathfinder, 16: 26582 (ACNP-6112)
AMERICAN CAN CO., BARRINGTON, ILL.
Prog. rpt. on food irradiation, 16: 25172 (NP-11726)
AMERICAN CYANAMID CO. ATOMIC ENERGY DIV., WATERTOWN, MASS.
Prog. rpt. on processing U ores, 16: 25464 (ACCO-15)
AMERICAN CYANAMID CO. ATOMIC ENERGY DIV. RAW MATERIALS DEVELOPMENT LAB., WINCHESTER, MASS.
Abrasive tests on ion exchange resins, 16: 25497 (ACCO-66)
Adsorption of U, 16: 25465 (ACCO-26)
Elution of U from anion exchange resins, 16: 25463 (ACCO-12)
Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
AMES LAB., AMES, IOWA.
Electrical resistivity of Th–Mg eutectic, 16: 25754 (IS-437)
Removal of Pu from U, 16: 25474 (IS-470)
ARGENTINA. COMISIÓN NACIONAL DE ENERGÍA ATÓMICA, BUENOS AIRES.
Magnetic deflector system of synchrocyclotron beam, 16: 26373 (NP-11693)
Magnetic deflector of synchrocyclotron beam, 16: 26374 (NP-11889)
ARGONNE NATIONAL LAB., ILL.
Chemical modification of radiation toxicity, 16: 25174 (TID-11988)
Distillation of UF_6 and BrF_3, 16: 25467 (ANL-6362)
Isolation of I without carrier, 16: 25264 (ANL-6577)
Prog. rpt. on physics, 16: 25877 (ANL-6534)
Prog. rpt. on reactor development, 16: 26455 (ANL-6573)
Reactor Fuel Processing, Vol. 5, No. 2, 16: 25493
ARIZONA STATE UNIV., TEMPE.
Prog. rpt. on rare earth oxides, 16: 25323 (TID-16350)
ARMY CHEMICAL CORPS NUCLEAR DEFENSE LAB., ARMY CHEMICAL CENTER, MD.
Broad range chemical dosimeter, 16: 25561 (NDL-TR-7)
ARMY ENGINEER RESEARCH AND DEVELOPMENT LABS., FORT BELVOIR, VA.
Prog. rpt. on SM-1 environmental radiological monitoring, 16: 25646 (ERDL-1691-TR)
ARMY MEDICAL RESEARCH UNIT NO. 1, LANDSTUHL ARMY MEDICAL CENTER, GERMANY
Prog. rpt. on biological aspects of radiation, 16: 25167 (NP-11884)
ARMY ORDNANCE MISSILE COMMAND, REDSTONE ARSENAL, ALA.
Design of ARGMA 8,000-kw plasma facility, 16: 25499 (ARGMA-TN-2H5N)
ARMY ROCKET AND GUIDED MISSILE AGENCY, REDSTONE ARSENAL, ALA.
Design of ARGMA 8,000-kw plasma facility, 16: 25499 (ARGMA-TN-2H5N)
ATOMIC ENERGY OF CANADA LTD., CHALK RIVER, ONT.
Control and safety in operation of NRX and NRU reactors, 16: 26614 (AECL-1486)
Decontamination of buildings, 16: 25498 (AECL-1531)
Fog density measurement, 16: 25551 (CRRP-1086)
Heat transfer coefficient between UO_2 and Zy-2, 16: 25523 (CRFD-1075)
Lattice measurements with 7-element UO_2 clusters, 16: 26461 (CRRP-1072)
PERT — Program evaluation and review technique, 16: 25081 (CRIO-1091)

Properties of ceramic fuels, 16: 25745 (AECL-1529)
ATOMICS INTERNATIONAL. DIV. OF NORTH AMERICAN AVIATION, INC., CANOGA PARK, CALIF.
Ceramic internal reflector for SNAP-8, 16: 25734 (NAA-SR-7293)
Control rod calibrations for SRE, 16: 26597 (NAA-SR-6585)
Critical heat flux in pool boiling, 16: 25525 (NAA-SR-Memo-6928)
Delta-phase isothermal hydriding of U–Zr, 16: 25756 (NAA-SR-6264)
Efficiency of thermionic converters, 16: 25908 (NAA-SR-Memo-7278)
High-pressure Na generator designs, 16: 25502 (NAA-SR-Memo-6849)
Power and stability tests on SRE, 16: 26223 (NAA-SR-7250)
Prog. rpt. on thermal properties of refractories, 16: 25837 (AD-270841)
Radiolysis of toluene, 16: 25412 (NAA-SR-6734)
Thermionic converters, 16: 26598 (NAA-SR-7144)
Transient and steady-state temperature in one-barrel cask, 16: 26471 (NAA-SR-Memo-6938)
TYCHE—Monte Carlo slowing down code, 16: 26197 (NAA-SR-7357)
AUSTRALIA. ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS, NEW SOUTH WALES.
Purification of CO_2 for reactor. III., 16: 25299 (AAEC/E-86)
AVCO CORP. AVCO-EVERETT RESEARCH LAB., EVERETT, MASS.
Deviation of MAST operation, 16: 25912 (NP-11848)
AVCO CORP. RESEARCH AND ADVANCED DEVELOPMENT DIV., WILMINGTON, MASS.
Reaction of glasses, graphite and refractories with Na, 16: 25318 (RAD-TM-60-44)
Ultrasonic temperature determinations in plasma, 16: 26404 (RAD-TR-61-13)

B

BABCOCK AND WILCOX CO., LYNCHBURG, VA.
Hazards report for BAWTR, 16: 26458 (BAW-183)
BARI, ITALY. UNIVERSITÀ.
Production of pion pairs by 14 Bev/c pions, 16: 25927 (NP-11977(p.66-7))
BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
Ceramic-coated nuclear-fuel particles, 16: 26476 (TID-7622(p.57-73))
Corrosion of Th and U, 16: 25713 (BMI-1563)
Fuel from alumina-coated UO_2 particles, 16: 25749 (BMI-1586)
Helium solubility in D_2O, 16: 25303 (BMI-1587)
Prog. rpt. on fission-product release from claddings, 16: 25750 (BMI-X-196)
Prog. rpt. on Nb-base alloys, 16: 25695 (BMI-X-188)
Prog. rpt. on UN, 16: 25839 (BMI-X-197)
Reactions between U oxide and bivalent metal oxides, 16: 25302 (BMI-1585)
Uranium oxide pressure-temperature-composition relationships, 16: 26483 (TID-7622(p.139-48))
Xenon-133 diffusion in alumina, 16: 26491 (TID-7622(p.245-53))
BATTELLE MEMORIAL INST. DEFENSE METALS INFORMATION CENTER, COLUMBUS, OHIO.
Chemical vapor disposition, 16: 25308 (DMIC-170)
Effect of molten alkali metals on containment metals, 16: 25714 (DMIC-169)
Effects of solutes on refractory metals, 16: 25751 (DMIC-Memo-155)
BATTELLE MEMORIAL INST. RADIATION EFFECTS INFORMATION CENTER, COLUMBUS, OHIO.
Radiation Effects Accession List No. 57, 16: 25844 (NP-11656)
BENDIX CORP. BENDIX SYSTEMS DIV., ANN ARBOR, MICH.
Radar cross section of plasma bodies, 16: 26396 (AD-268824)
BENDIX CORP. BENDIX PRODUCTS AEROSPACE DIV., SOUTH BEND, IND.
Prog. rpt. on materials, 16: 25744 (AD-269196)
BOEING CO., SEATTLE.
Influence of crystal field on ion-core states, 16: 25884 (D1-82-0171)
Parallel plate plasma problem, 16: 25552 (D1-82-0173)
Plasmas in InSb in magnetic fields, 16: 26400 (D1-82-0172)
BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Analysis of parameters of U-233, U-235, and Pu-239, 16: 26216 (BNL-722)
Bibliography on γ radiography, 16: 25604 (BNL-716)
Fluorocarbons in reactor technology, 16: 26480 (TID-7622(p.109-20))
Isotope effects on intermolecular interactions, 16: 25304 (BNL-6050)
Polymerization of ethylene by γ rays, 16: 25409 (BNL-740)
THERMOS code for reactor lattice calculations, 16: 26459 (BNL-5826)
Wind profile in lower 400 ft of atmosphere, 16: 25611 (BNL-718)
BROWN BOVERI/KRUPP REAKTORBAU GMBH, MANNHEIM, GERMANY.
Fission product activity in loop, 16: 26498 (AEC-tr-5212)
BROWN UNIV., PROVIDENCE.
Prog. rpt. on high-energy physics, 16: 25952 (TID-16011)
Properties of solids by ultrasonic methods, 16: 25547 (AROD-2302.8)
BRUSH BERYLLIUM CO., CLEVELAND.
Properties of intermetallic compounds, 16: 25748 (ASD-TDR-62-476)
BRUSSELS. CENTRE D'ÉTUDE DE L'ÉNERGIE NUCLÉAIRE.
Bibliography on Te-132, 16: 25301 (BLG/B-1)
Paper chromatography of Te(IV) and Te(VI), 16: 25265 (BLG/B-4)
Prog. rpt. on waste disposal, 16: 26636 (EURAEC-84)
BUREAU OF MINES, PITTSBURGH.
Hydrogenation of irradiated coal, 16: 25408 (BM-RI-6022)

C

CALIFORNIA INST. OF TECH., PASADENA.
Ages of Fe meteorites, 16: 25614 (JPL-TR-32-147)
Bubble density measurement, 16: 25883 (CTSL-33)
Nuclear-electric spacebus, 16: 26628 (JPL-TR-32-231)
CALIFORNIA. UNIV., BERKELEY. LAWRENCE RADIATION LAB.
Coalescence of liquid drops, 16: 25956 (UCRL-10097)
Multipion resonances in reaction $p + p \rightarrow 3\pi^+ + 3\pi^- + n\pi^0$, 16: 26233 (UCRL-10129)
Probe theory in dense plasma, 16: 26405 (UCRL-10128)
Reactions of π^- mesons, 16: 26232 (UCRL-9884)
Scattering of π^- on protons, 16: 26093 (UCRL-10252)
CALIFORNIA. UNIV., DAVIS.
Prog. rpt. on effects of radiation on dog, 16: 25183 (UCD-105)
Prog. rpt. on Sr-90 ingestion, 16: 25153 (UCD-106)
CALIFORNIA. UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Bibliography on analyses of Pu and Pu alloys, 16: 25273 (UCRL-6873)
Production of H^+ from H_2, 16: 25955 (UCRL-6925)
Tory II-A neutronic machine calculations, 16: 26632 (UCRL-6304)
CALIFORNIA. UNIV., LOS ANGELES.
Changes across irradiated rat intestinal villi, 16: 25180 (TID-16271)
Mucopolysaccharides in post-irradiation intestinal absorption, 16: 25179 (TID-16270)
CANADA. DEPT. OF NATIONAL HEALTH AND WELFARE, OTTAWA.
Prog. rpt. on radioactive fall-out monitoring, 16: 25616 (NP-11914)
CANADA. SUFFIELD EXPERIMENTAL STATION, RALSTON, ALBERTA.
Comments on cratering, 16: 25503 (NP-11816)
Ground displacement from surface burst, 16: 25087 (NP-11817)
CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., CHARLOTTE, N. C.
Design of CVTR pressure tube, 16: 26585 (CVNA-95)
Development of the CVTR moderator tank, 16: 26586 (CVNA-108)
Prog. rpt. on CVTR project, 16: 26600 (WCAP-4126)
CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., COLUMBIA, S. C.
Computer analysis of loss-of-coolant accident, 16: 26587 (CVNA-117 (Vol.I))
Computer analysis of loss-of-coolant accident. II., 16: 26588 (CVNA-117 (Vol.II))
Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
CENTRO INFORMAZIONI STUDI ESPERIENZE, MILAN.
Prog. rpt. on CAN-1, 16: 26603 (EURAEC-36)
Prog. rpt. on CAN-1, 16: 26604 (EURAEC-38)
Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
CHICAGO. UNIV. ENRICO FERMI INST. FOR NUCLEAR STUDIES.
Hyperon-nucleon scattering, 16: 26091 (NYO-10234)
CHICAGO. UNIV. LABS. FOR APPLIED SCIENCE.
Prog. rpt. on applications of isotopes, 16: 25271 (TID-16156)
Prog. rpt. on radioisotopes research, 16: 25682 (TID-16013)
COLOGNE. UNIVERSITÄT.
Prog. rpt. on biogenic amines in radiation injuries, 16: 25250 (NP-11753)
COLORADO. UNIV., DENVER. SCHOOL OF MEDICINE.
Chemical protection of irradiated mice, 16: 25252 (TID-16160)
Prog. rpt. on radioprotective agents, 16: 25251 (TID-16159)

COLUMBIA UNIV., IRVINGTON-ON-HUDSON, N. Y. NEVIS LABS.
Mu mesonic atom studies of Ti, Fe, Cu, Zn, Tl, Pb, and Bi, 16: 25909 (NEVIS-105)
COLUMBIA UNIV., NEW YORK.
Heat transfer in eccentric annuli, 16: 25526 (NYO-9649)
COMBUSTION ENGINEERING, INC., WINDSOR, CONN.
Steam driven coolant pumps, 16: 26584 (CEND-150(Pt.IV))
COMBUSTION ENGINEERING, INC. NUCLEAR COMPONENTS ENGINEERING DEPT., CHATTANOOGA.
Gas cooled reactor study, 16: 26497 (TID-16138)
CONNECTICUT. UNIV., STORRS.
Prog. rpt. on analytical chemistry, 16: 25272 (TID-16332)
CONSOLIDATION COAL CO. RESEARCH AND DEVELOPMENT DIV., LIBRARY, PENNA.
Prog. rpt. on β radiation as hydrogenation catalyst, 16: 25414 (NYO-10184)
CONTINENTAL CAN CO., INC., CHICAGO.
Packaging for radiation pasteurized foods, 16: 25681 (TID-15144)
CORNELL AERONAUTICAL LAB., INC., BUFFALO.
Effects of outer-space environment, 16: 26627 (ASD-TR-61-201)
CORNELL UNIV., ITHACA, N. Y.
Alignment procedures in x-ray spectrometry, 16: 25545 (AFOSR-2418)
Excitation and ionization of inner atomic shells by x rays, 16: 25873 (AFOSR-1732)
Magnetohydrodynamic flow about blunt body, 16: 25874 (AFOSR-2714)
Oxide nucleation and growth, 16: 25716 (NP-11876)
Photoproduction of π^0 mesons from H_2, 16: 25936 (NP-11977(p.102-4))

D

DENMARK. ATOMENERGIKOMMISSIONEN. FORSØGSINSTITUT, RISØ.
Environmental radioactivity in Denmark, 1961, 16: 25169 (RISO-41)
DENVER. UNIV. DENVER RESEARCH INST.
Prog. rpt. on scavenging W and Mo, 16: 25696 (DRI-2010)
DEUTSCHES ELEKTRONEN-SYNCHROTRON, HAMBURG.
Pole surface face windings for DESY magnets, 16: 26370 (DESY-A1.9)
DIVISION OF REACTOR DEVELOPMENT, AEC.
Reactors in U. S. as of June 30, 1962, 16: 26496 (TID-8200(6th Rev.))
DIVISION OF TECHNICAL INFORMATION EXTENSION, AEC.
Bibliography on radioactive fall-out, 16: 25617 (TID-3086(Suppl. I))
DU PONT DE NEMOURS (E. I.) & CO. SAVANNAH RIVER LAB., AIKEN, S. C.
Bucklings of Pu–H_2O, 16: 26463 (DP-701)
Diffusion coefficient of α emitter in solid, 16: 25309 (DP-727)
Dissolving Pu metal in sulfamic acid, 16: 25310 (DP-737)
Sampling valve for reactor coolant, 16: 26462 (DP-658)
DUQUESNE LIGHT CO., SHIPPINGPORT, PENNA.
Data logging and computing system calibration test, 16: 26591 (DLCS-4000301(Rev.))
Reactor plant container air cooling, 16: 26590 (DLCS-3960101)

E

EAGLE-PICHER CO., MIAMI, OKLA.
Purification of CdS crystals, 16: 25878 (ARL-62-319)
EAST CENTRAL NUCLEAR GROUP.
Gas-cooled, heavy water-moderated pressure-tube reactor, 16: 26594 (GNEC-74)
Prog. rpt. on GCR Project, 16: 26595 (GNEC-82)
EITEL-McCULLOUGH, INC., SAN CARLOS, CALIF.
Heating of materials by electron beams, 16: 26065 (AFCRL-975)
ELECTRO-OPTICAL SYSTEMS, INC., PASADENA, CALIF.
Prog. rpt. on solar cells, 16: 25845 (NP-11759)
ETHYL CORP. RESEARCH AND DEVELOPMENT DEPT., DETROIT.
Prog. rpt. on synthesis of organolanthanide derivations, 16: 25321 (TID-16224)
EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, GENEVA.
Accelerator research at CERN, 16: 25917 (NP-11977 (p.2-5))
Elementary theory of weak interactions, 16: 26067 (CERN-62-17)
Ionization measurements from H_2 bubble chamber, 16: 25921 (NP-11977 (p.45-48))
Present ideas on 25-Bev proton storage rings, 16: 25918 (NP-11977 (p.5-20))
Production of pion pairs by 14 Bev/c pions, 16: 25927 (NP-11977(p.66-7))

F

FEDERAL CIVIL DEFENSE ADMINISTRATION, WASHINGTON, D. C.
Family shelter evaluation, 16: 25657 (WT-359)
FLORENCE. UNIVERSITÀ.
Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
FLORIDA STATE UNIV., TALLAHASSEE.
Prog. rpt. on physics, 16: 25910 (NP-11749)
FLORIDA WEST COAST NUCLEAR GROUP, INC., ST. PETERSBURG, FLA.
Gas-cooled, heavy water-moderated pressure-tube reactor, 16: 26594 (GNEC-74)
Prog. rpt. on GCR Project, 16: 26595 (GNEC-82)
FRANCE. COMMISSARIAT À L'ENERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, FONTENAY-AUX-ROSES.
Absorption of Sr and Cs by plants, 16: 25642 (CEA-2159)
Dose received after single absorption of fission product, 16: 25643 (CEA-2163)
Handling of PuF_4, 16: 25473 (CEA-2123)
FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, GRENOBLE.
Apparatus for irradiating in swimming pool reactor, 16: 26615 (CEA-2134)
Neutron moderation, 16: 26193 (CEA-2012)
FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, SACLAY.
Biological study of luminous paint, 16: 25110 (CEA-2155)
Chemical properties of elements in molten LiCl, 16: 25306 (CEA-2125)
Concentration control in isotope separation plant, 16: 25686 (CEA-2160)
Dissolved gases in water of swimming pool reactor, 16: 26495 (TID-7622 (p.310-15))
Fixing of phosphoric ions by Zr–montmorillonite, 16: 25305 (CEA-1650)
Isotopic effect during reaction of cuprous oxide, 16: 25410 (CEA-2120)
Physical constants of isotopic substitutions in water, 16: 25307 (CEA-Bib-15)
Physical measurements in Marcoule reactors, 16: 26460 (CEA-2158)
Physics experiments in graphite lattices, 16: 26063 (CEA-2157)
Possibility of 15-Bev proton accelerator, 16: 25919 (NP-11977(p.20-31))
Sintering theory, 16: 25698 (NP-11636)
Vitrification of solutions of fission products, 16: 26634 (CEA-2130)
FRANCE. COMMISSARIAT À L'ENERGIE ATOMIQUE. CENTRE DE PRODUCTION DE PLUTONIUM DE MARCOULE, CHUSCLAN.
Measurement of integrated doses by mechanography, 16: 25550 (CEA-2128)
FRANCE. INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE, PARIS.
Absorption of Sr and Cs by plants, 16: 25642 (CEA-2159)
FRANCE. INSTITUT NATIONAL DES SCIENCES ET TECHNIQUES NUCLÉAIRES, PARIS.
HF-type particle separators, 16: 26369 (CEA-2109)
FRANKFORD ARSENAL, PHILADELPHIA.
Nuclear pulse testing of camera heads, 16: 25836 (AD-270724)

G

GENERAL ATOMIC DIV., GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.
Analysis of radial arm indexing mechanism. Top transfer machine, 16: 26465 (GAMD-1318)
Coating Th–U carbides with C, 16: 25731 (GA-2241)
Fission product retention studies of graphite reactor fuels, 16: 26486 (TID-7622(p.171-92))
Maritime GCR land-based prototype, 16: 26592 (GAMD-1722)
Prog. rpt. on rare-earth abundances in meteorites, 16: 25648 (GA-2782 (Rev.))
Release of K and Xe fission products from (U,Th)C_2–graphite fuel matrix, 16: 25752 (GA-3211)
Removal of radioactive Kr and Xe from flowing He stream, 16: 26489 (TID-7622(p.218-35))

Thermal conductivity of graphite above 2000°F, 16: 25753 (GAMD-2089)
TNT—program for analyzing transient performance of HTGR fission product trapping system, 16: 26593 (GAMD-3168)

GENERAL DYNAMICS/FORT WORTH. DIV. OF GENERAL DYNAMICS CORP., FORT WORTH, TEX.

Effects of radiation on elastomers and plastics, 16: 25843 (NARF-62-5T)

GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION DEPT., CINCINNATI.

Induction heating application test, 16: 25605 (DC-55-11-47)

GENERAL ELECTRIC CO. ATOMIC POWER EQUIPMENT DEPT., SAN JOSE, CALIF.

Plutonium fuel processing and fabrication, 16: 25697 (GEAP-3876)

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Diffusion of charged particles in parabolic potential well, 16: 25885 (GEST-2002)

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Calculation of neutron flux, 16: 26432 (APEX-652)
Program 20-8, for interpreting program 18-0, 16: 26466 (GEMP-123)
Pyrolytic graphite rocket nozzle components, 16: 25728 (AD-270153)
P122C control actuator, 16: 26457 (APEX-729)

GENERAL ELECTRIC CO. FLIGHT PROPULSION LAB. DEPT., EVENDALE, OHIO.

Recoil loss from ceramic fuel elements, 16: 26487 (TID-7622(p.193-206))

GENERAL ELECTRIC CO. GENERAL ENGINEERING LAB., SCHENECTADY, N. Y.

Condenser analysis, 16: 25540 (AD-269401)
Power control of double-acting "steamotor," 16: 25539 (AD-269391)

GENERAL ELECTRIC CO. HANFORD ATOMIC PRODUCTS OPERATION, RICHLAND, WASH.

Autoradiographic localization of Zn-65, 16: 25133 (HW-72500(p.97-101))
Beta field dose rate determination, 16: 25650 (HW-52448)
Biological effects of I-131 in sheep and swine, 16: 25118 (HW-72500 (p.30-5))
Changes following inhalation of $Pu^{239}O_2$, 16: 25126 (HW-72500(p.67-73))
Chinook salmon spawning in the Columbia River, 16: 25144 (HW-72500(p. 148-50))
Decontamination of wastes containing ammonia, 16: 26638 (HW-71627)
Delayed effects of Y-90 ingestion, 16: 25131 (HW-72500(p.88-91))
Developmental arrest of irradiated Ephestia larvae, 16: 25134 (HW-72500(p.102-3))
Disposal of radioactive liquid wastes, 16: 26637 (HW-64292)
Distribution and retention of Sr^{90}–Y^{90} in trout, 16: 25117 (HW-72500 (p.26-9))
Effect of age on retention of Sr and Ca, 16: 25113 (HW-72500(p.13-14))
Effect of DNP on Ca accumulation and transpiration, 16: 25140 (HW-72500(p.128-33))
Effect of nutrient K and Cs on uptake of Cs-137, 16: 25141 (HW-72500 (p.134-8))
Effectiveness of I-127 as diluent of I-131 aerosol, 16: 25123 (HW-72500 (p.52-5))
Effects of chloramphenicol on cation absorption by plants, 16: 25139 (HW-72500(p.123-7))
Effects of D_2O on yeast, 16: 25137 (HW-72500(p.113-18))
Effects of intradermal injections of Pu, 16: 25122 (HW-72500(p.50-1))
Effects of radiation on regenerating liver, 16: 25132 (HW-72500(p.92-6))
Effects of Sr-90 in miniature swine, 16: 25112 (HW-72500(p.1-12))
Effects of x radiation on proliferating cells, 16: 25135 (HW-72500(p.104-8))
Fission product release from U, 16: 25841 (HW-72321)
Green Glow diffusion program, 16: 25612 (HW-71400(Vol.I))
Hanford ground water flow, 16: 25613 (HW-73711)
Harvest yields in natural plant communities, 16: 25147 (HW-72500(p.159-60))
Heavy water losses in PRTR, 16: 26616 (HW-73755)
Incidence and virulence of columnaris, 16: 25145 (HW-72500(p.151-5))
Inhalation of dust containing Np-237, 16: 25124 (HW-72500(p.56-60))
Interrelationships of Ca, Sr, and phosphate in serum, 16: 25115 (HW-72500(p.19-22))
Intestinal absorption of Sr-85 and Ca-45, 16: 25114 (HW-72500(p.15-18))
Loading Sr-90 on Decalso for cask shipment, 16: 25651 (HW-71574)
Metabolism of Np, 16: 25120 (HW-72500(p.41-3))
Movement of Sr across the gill of trout, 16: 25116 (HW-72500(p.23-5))
Producers and decomposers in a desert soil, 16: 25148 (HW-72500 (p.161-4))
Prog. rpt. on biology, 16: 25111 (HW-72500)
Prog. rpt. on radioactive residues, 16: 26639 (HW-73412)
Prog. rpt. on reactor development, 16: 26467 (HW-73100)
Protection against repeated partial-body irradiation, 16: 25129 (HW-72500(p.81-3))
Radioisotopes in studying waterfowl dispersion, 16: 25142 (HW-72500 (p.139-43))
Radionuclides in Arctic plants and animals, 16: 25149 (HW-72500(p.165-9))
Reactor effluent monitoring with salmon, 1960-1961, 16: 25143 (HW-72500(p.144-7))
Removal of internally deposited Pu, 16: 25128 (HW-72500(p.77-80))
Removing inhaled radioactive particles, 16: 25127 (HW-72500(p.74-6))
Retention, translocation, and excretion of inhaled Pu, 16: 25125 (HW-72500(p.61-6))
Toxicity of Sr-90, Ra-226, and Pu-239, 16: 25119 (HW-72500(p.36-40))
Transfer of heavy radionuclides to milk, 16: 25121 (HW-72500(p.44-9))
Trunc retaining ring failure, 16: 26612 (HW-73643)
Uptake and distribution of thymidine by yeast, 16: 25136 (HW-72500 (p.109-12))
Uptake of arsenate by barley plants, 16: 25138 (HW-72500(p.119-22))
Uranium swelling studies, 16: 25840 (HW-65453)
Water absorption from intestine to lymph and blood, 16: 25130 (HW-72500(p.84-7))
X-ray tolerance of two related species of beetles, 16: 25146 (HW-72500 (p.156-8))

GENERAL ELECTRIC CO. MISSILE AND SPACE DIV., VALLEY FORGE SPACE TECHNOLOGY CENTER, KING OF PRUSSIA, PENNA.

Electron distribution function of ionized gas, 16: 25951 (R62SD64)

GENERAL ELECTRIC CO. RESEARCH LAB., SCHENECTADY, N. Y.

Dispersion hardening, 16: 25693 (ARL-62-357)
Spontaneous magnetization in solid bodies, 16: 25882 (ASD-TR-61-630)

GENERAL ELECTRIC CO. VALLECITOS ATOMIC LAB., PLEASANTON, CALIF.

Diffusion of charged particles in parabolic potential well, 16: 25885 (GEST-2002)

GENERAL MOTORS CORP. ALLISON DIV., INDIANAPOLIS.

Efficiency of rail accelerators, 16: 26367 (AFOSR-1631)

GENERAL NUCLEAR ENGINEERING CORP., DUNEDIN, FLA.

Bonus type superheater fuel assembly, 16: 25732 (GNEC-197)
Gas-cooled, heavy water-moderated pressure-tube reactor, 16: 26594 (GNEC-74)
Prog. rpt. on GCR Project, 16: 26595 (GNEC-82)

GENERAL TELEPHONE AND ELECTRONICS LABS. INC., BAYSIDE, N. Y.

Prog. rpt. on electron tube materials and thermionic emission, 16: 25944 (AFCRL-62-2)

GEOPHYSICS CORP. OF AMERICA, BEDFORD, MASS.

Vacuum gage calibration, 16: 25553 (GCA-TR-61-19-N)

GT. BRIT. MEDICAL RESEARCH COUNCIL, LONDON.

Assay of Sr-90 in bone, 16: 25168 (NP-11904)

GT. BRIT. MINISTRY OF HEALTH.

Code of practice for display of radiation sources, 16: 25679

GT. BRIT. MINISTRY OF LABOUR, LONDON.

Ionization radiations: precautions, 16: 25680

GT. BRIT. NATIONAL CHEMICAL LAB., TEDDINGTON, MIDDX., ENGLAND.

Extraction of U from ores, 16: 25468 (NCL/AE-197)
Solvent extraction of Be, 16: 25475 (NCL/AE-172)

GT. BRIT. NATIONAL PHYSICAL LAB., TEDDINGTON, MIDDX., ENGLAND.

Radiometric standards and measurements, 16: 25595

GRENOBLE, FRANCE. UNIVERSITÉ.

Neutron moderation, 16: 26193 (CEA-2012)

H

HAHN-MEITNER-INSTITUT FUR KERNFORSCHUNG BERLIN.

Fifth annual report, 16: 25083 (HMI-B-22)

HARVARD UNIV., CAMBRIDGE, MASS.
Fracture of metals, 16: 25759 (NP-11890)
HUGHES RESEARCH LABS. DIV. OF HUGHES AIRCRAFT CO., MALIBU, CALIF.
Prog. rpt. on H_2^+ dissociation, 16: 26092 (TID-16031)

I

IDAHO OPERATIONS OFFICE, AEC.
Prog. rpt. on health and safety, 16: 25652 (IDO-12021)
ILLINOIS INST. OF TECH., CHICAGO. ARMOUR RESEARCH FOUNDATION.
Possibility study of new mass flow system, 16: 25521 (ARF-1167-18)
Materials for resistance strain gages, 16: 25560 (NAMC-ASL-1050(Pt.III))
Prog. rpt. on magnetic properties of insulators, 16: 25838 (ARF-1184-5)
Prog. rpt. on Zr alloys, 16: 25746 (ARF-2230-9)
Resistance strain gages, 16: 25559 (NAMC-ASL-1050(Pt.II))
ILLINOIS. UNIV., URBANA.
Electrostatic instability of particles penetrating a plasma, 16: 26397 (AD-269051)
High energy bunched electron beams, 16: 26368 (AFOSR-2580)
Multinucleon capture of K^- mesons, 16: 26084 (NP-11623)
Point defects in deformed f.c.c. metals, 16: 25764 (TID-16222)
Theory of periodic deviations in Schottky effect, 16: 25954 (TID-16225)
Transistorized voltage control for magnet, 16: 25566 (NP-11883)
Transmission and line broadening in Mössbauer effect, 16: 26225 (NP-11913)
Transverse polarization of conversion electrons following β decay, 16: 26086 (NP-11737)
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA.
Physics of fast and intermediate reactors. I., 16: 26503 (STI/PUB/49 (Vol.I))
Physics of fast and intermediate reactors. II., 16: 26535 (STI/PUB/49 (Vol.II))
Physics of fast and intermediate reactors. III., 16: 26554 (STI/PUB/49 (Vol.III))
ISRAEL. ATOMIC ENERGY COMMISSION, REHOVOTH.
Determination of Te in presence of Bi, 16: 25267 (IA-724)
ISRAEL INST. OF TECH., HAIFA.
Investigations on fields, 16: 26066 (ARL-62-332)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, CASACCIA.
Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ISPRA.
Conductivity in plastically deformed alkali halides, 16: 25316 (NP-11921)
Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
Luminescence of alkali halides, 16: 25914 (NP-11920)
Neutron flux distribution gage, 16: 25562 (NP-11705)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ROME.
Determination of rare earths in U compounds, 16: 25266 (CNEN-135)
Influence of extraction hole on neutron spectra, 16: 26199 (NP-11932)
Pulse scaler and ferrite core preselector, 16: 25563 (NP-11735)
TIMER—Programmer with ferrite cores, 16: 25564 (NP-11822)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE. LABORATORI NAZIONALI, FRASCATI.
Congress on high-energy physics, Frascati, Feb. 7-9, 1962, 16: 25886 (LNF-62/37)
Congress on high-energy physics, Frascati, Dec. 16-17, 1960, 16: 25916 (NP-11977)
Construction of storage rings, 16: 25905 (LNF-62/37(p.161-5))
Cross section of the process $\gamma + p \rightarrow \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
Elements of plan of 10-Bev electron synchrotron, 16: 25929 (NP-11977 (p.78-80))
Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))
Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37(p.105-9))
Photoproduction of μ-meson couples on nuclei, 16: 25931 (NP-11977 (p.90-2))
Polarization of recoil protons, 16: 25939 (NP-11977(p.111-15))
Polarized photon beam from Frascati synchrotron, 16: 25932 (NP-11977(p.93-4))
Production of π^0 by polarized photons, 16: 25934 (NP-11977(p.97-99))
Scintillation chambers, 16: 25940 (NP-11977(p.116-20))
Some problems of high-energy physics, 16: 25928 (NP-11977(p.71-7))
Storage ring for electrons and positrons (Adone), 16: 25930 (NP-11977 (p.80-8))
Study on the process $\gamma + p \rightarrow \eta + p$, 16: 25897 (LNF-62/37(p.89-98))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, BOLOGNA.
Decay of positive K mesons, 16: 25920 (NP-11977(p.40-4))
Parity conservation pion production, 16: 25889 (LNF-62/37(p.13-23))
Parity conservation in the reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$, 16: 25944 (NP-11977(p.127-9))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, FLORENCE.
Coulomb photoproduction of π^0 on nuclei, 16: 25893 (LNF-62/37(p.57-71))
Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, GENOA.
Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, MILAN.
Ionization measurements from H, bubble chamber, 16: 25921 (NP-11977(p.45-48))
Production of pion pairs by 14 Bev/c pions, 16: 25927 (NP-11977(p.66-7))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, PADUA.
Electromagnetic form factors of mesons and baryons, 16: 25896 (LNF-62/37(p.81-8))
Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37 (p.72-5))
Measuring the reaction $e^+ + e^- \rightarrow K^+ + K^-$, 16: 25906 (LNF-62/37(p.166-79))
Photoproduction of π^+ with polarized photons, 16: 25935 (NP-11977 (p.99-100))
Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37(p.76-80))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, PISA.
Coulomb photoproduction of π^0 on nuclei, 16: 25893 (LNF-62/37(p.57-71))
Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, ROME.
Double photoproduction reactions, 16: 25887 (LNF-62/37(p.7-9))
Double photoproduction of charged pions, 16: 25942 (NP-11977(p.121-3))
Experiments with β at CERN, 16: 25926 (NP-11977(p.64-5))
Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37 (p.72-5))
Measuring the reaction $e^+ + e^- \rightarrow K^+ + K^-$, 16: 25906 (LNF-62/37(p.166-79))
Photoproduction of π^+, 16: 25891 (LNF-62/37(p.34-9))
Photoproduction of π^0 from polarized γ, 16: 25933 (NP-11977(p.94-6))
Photoproduction of π^+ with polarized photons, 16: 25935 (NP-11977 (p.99-100))
Photoproduction of pions in H_2 and D_2, 16: 25943 (NP-11977(p.124-6))
Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
Photoproduction of K mesons in H_2, 16: 25947 (NP-11977(p.137-9))
Polarization of neutrons, 16: 25922 (NP-11977(p.49-52))
Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
Radiative capture of μ mesons, 16: 25923 (NP-11977(p.53-4))
Use of He bubble chamber, 16: 25925 (NP-11977(p.60-2))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, TRIESTE.
Prog. rpt. of Trieste group, 16: 25924 (NP-11977(p.55-7))
ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, TURIN.
Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
Nuclear emulsions in Adone experiments, 16: 25907 (LNF-62/37(p.180-3))
ITALY. ISTITUTO SUPERIORE DI SANITÀ, ROME.
Capture of π^- mesons in complex nuclei, 16: 25902 (LNF-62/37(p.138-42))
Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))
Photoproduction of neutral mesons, 16: 25898 (LNF-62/37(p.98-104))
Photoproduction of π^0 mesons from H_2, 16: 25936 (NP-11977(p.102-4))
Research program with "light" of Frascati synchrotron, 16: 25903 (LNF-62/37(p.142-56))

ITALY. ISTITUTO NAZIONALE DI FISICA NUCLEARE, NAPLES.
Interaction of high-energy photons with heavy nuclei, 16: 25949 (NP-11977(p.144-6))
Photofission and nuclear photodisintegration, 16: 25900 (LNF-62/37 (p.115-17))
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Prog. rpt. on reactor fuel management, 16: 26464 (EURAEC-255)

J

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JEFFERSON MEDICAL COLL., PHILADELPHIA.
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Amplitudes of π-meson production from neutrino by nucleon, 16: 26074 (JINR-P-905)
Angular distribution of π mesons, 16: 26082 (JINR-P-981)
Annular phasotron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
Anomalies in μ^- meson decay in paramagnetic metals, 16: 26080 (JINR-P-972)
Determination of Ac-225 and Ac-226 produced in U and Th bombardment, 16: 25411 (JINR-P-978)
Edge problem in dispersion ratios, 16: 26077 (JINR-P-949)
Effects of π-π interaction on S- and p-waves in π-N scattering, 16: 26076 (JINR-P-938)
Equations of Chu-Low type for $\pi + N \to 2\pi + N$ process, 16: 26072 (JINR-P-891)
Excitations of EM waves in plasma, 16: 26401 (JINR-P-917)
Interactions of particles at high energies, 16: 26071 (JINR-P-817)
Magnetic field power lines, 16: 26402 (JINR-P-929)
Mandelstam's equations for π-π scattering, 16: 26069 (JINR-E-943)
Non-renormalization theories, 16: 26079 (JINR-P-964)
Nonlinear resonances in relativistic cyclotron, 16: 26372 (JINR-P-931)
On $T + T \to He^4 + 2n$ reaction, 16: 26075 (JINR-P-911)
Production of At-209 and At-207, 16: 26220 (JINR-P-950)
Production of ΛK^0 and $K^0\bar{K}^0$ pairs in π^-p interactions, 16: 26068 (JINR-D-965)
Properties of K^0K^0 meson pairs, 16: 26078 (JINR-P-960)
Properties of π^- mesons, 16: 26081 (JINR-P-974)
Properties of transuranic elements, 16: 26217 (JINR-E-932)
Quantum electrodynamics in terms of electromagnetic field strengths, 16: 26433 (JINR-E-975)
Recording of nuclear fission fragments, 16: 25558 (JINR-P-979)
Regge-poles and elastic scattering, 16: 26070 (JINR-E-991)
Regularization method in field theory, 16: 26434 (JINR-E-977)
S-matrix for one-dimensional Schroedinger equation, 16: 26435 (JINR-P-906)
Theory of even-even non-spherical nuclei, 16: 26218 (JINR-P-923)
Transfer of neutrons in Al, Cu, and Ta bombardment, 16: 26221 (JINR-P-973)
Transition of negative mesons from H, 16: 26219 (JINR-P-942)
Unobserved region in photoproduction dispersion ratios, 16: 26073 (JINR-P-904)

K

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Isotopic effect during reaction of cuprous oxide, 16: 25410 (CEA-2120)

M

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
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Joining of refractory metals—W, 16: 25737 (WAL-TR-460.54/1-2)
Magnetohydrodynamic flow, 16: 25913 (NP-11892)
Underground nuclear detection, 16: 25610 (AFCRL-863)
MELLON INST., PITTSBURGH.
Prog. rpt. on corrosion of steels and alloys, 16: 25717 (NP-11948)
Prog. rpt. on radiation research, 16: 25419 (RRL-84)
MICHIGAN. UNIV., ANN ARBOR.
Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
Prog. rpt. on 83-inch cyclotron, 16: 26375 (TID-16329)
MIDWEST APPLIED SCIENCE CORP., LAFAYETTE, IND.
Efficiency of rail accelerators, 16: 26367 (AFOSR-1631)
MOUND LAB., MIAMISBURG, OHIO.
Plutonium-bearing glass for reactor fuel, 16: 26478 (TID-7622(p.86-97))

N

NARMCO RESEARCH AND DEVELOPMENT. DIV. OF TELECOMPUTING CORP., SAN DIEGO, CALIF.
Prog. rpt. on high-temperature adhesives, 16: 25699 (NP-11815)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD SPACE FLIGHT CENTER, GREENBELT, MD.
Delineation of tracks of cosmic rays, 16: 25546 (AFOSR-3030)
Solar protons, 16: 26052 (NASA-TN-D-1139)
NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.

Coatings for refractory metals, 16: 25701 (WADD-TR-61-64)
Thermodynamic properties of gases, 16: 25875 (AFSWC-TDR-62-21)
NATIONAL RESEARCH COUNCIL. MATERIALS ADVISORY BOARD.
Materials research and development, 16: 25755 (MAB-180-M(Vol.II))
Prog. rpt. on forging and extrusion, 16: 25733 (MAB-139-M(F4))
State of art on machining, 16: 25501 (MAB-139-M(M5))
NAVAL MATERIAL LAB., BROOKLYN.
Prog. rpt. on thermal radiation studies, 16: 25876 (AFSWP-844)
NAVAL RADIOLOGICAL DEFENSE LAB., SAN FRANCISCO.
Residual contamination of clothing and materials, 16: 25656 (USNRDL-TR-557)
Response requirements for radiacs. III., 16: 25572 (USNRDL-TR-567)
Vapor pressures in $Rb_2O-B_2O_3$, 16: 25325 (USNRDL-TR-566)
NEW YORK OPERATIONS OFFICE. HEALTH AND SAFETY LAB., AEC.
Effect of noise on pulse height resolution, 16: 25554 (HASL-118)
Survey of fall-out operations, 16: 25649 (HASL-128)
NEW YORK UNIV., NEW YORK.
Histochemical and biological alterations following irradiation, 16: 25175 (TID-16051)
Prog. rpt. on measurement of environmental radiation, 16: 25170 (TID-16123)
Prog. rpt. on radiation-induced phenomena, 16: 25413 (NP-11882)
NORGES TEKNISKE HOGSKØLE, TRONDHEIM.
Kenner-algebra and Foldy-Wouthuysen transformations for particles with spin 0 and 1, 16: 26088 (NP-11781)
NORTH CAROLINA STATE COLL., RALEIGH.
Time correlation method for two connected nuclear transformations, 16: 26215 (AROD-2543.5)
NORTH CAROLINA. UNIV., CHAPEL HILL.
Delineation of tracks of cosmic rays, 16: 25546 (AFOSR-3030)
NORTHERN STATES POWER CO., MINNEAPOLIS.
Preoperational and nuclear testing of Pathfinder, 16: 26582 (ACNP-6112)
NORWAY. INSTITUTT FOR ATOMENERGI, KJELLER.
Description of I.F.A. corrosion loop, 16: 25715 (KR-14)
NUCLEAR MATERIALS AND EQUIPMENT CORP., APOLLO, PENNA.
Coatings for UO_2 and U particles, 16: 26479 (TID-7622(p.98-107))
Prog. rpt. on Pu fuels, 16: 25736 (NUMEC-P-100)
NUCLEAR METALS, INC., CONCORD, MASS.
Prog. rpt. on power reactors, 16: 25735 (NMI-7251)
Prog. rpt. on solubility of gases in Be, 16: 25757 (NMI-9815)

O

OAK RIDGE GASEOUS DIFFUSION PLANT, TENN.
Determination of Mo–U ratios in hexafluoride mixtures, 16: 25313 (K-1433)
OAK RIDGE NATIONAL LAB., TENN.
Accountability measurements program for fuel reprocessing, 16: 25479 (ORNL-TM-288)
Bibliography on reactor fuel reprocessing and waste disposal. IV., 16: 25476 (ORNL-2971(Vol.4))
Conference on nuclear reactor chemistry, 16: 26472 (TID-7622)
Control of pot calciner temperatures, 16: 26640 (ORNL-TM-259)
Evolution of gas from graphites, 16: 26474 (TID-7622(p.24-34))
Fission products from reactor-grade UO_2, 16: 26484 (TID-7622(p.149-59))
Fuel cycles and loading for water-cooled research reactors, 16: 26620 (ORNL-TM-277)
Gas cooled reactor study, 16: 26497 (TID-16138)
KINEMATICS II—nonrelativistic Fortran program, 16: 26227 (ORNL-3251)
Kinetics of uranyl sulfate exchange, 16: 25478 (ORNL-3296)
Labyrinth seal; theory and design, 16: 25505 (TID-15986)
Mechanical face seal, sealing theory, 16: 25507 (TID-15988)
Monte Carlo calculation of scattered neutron fluxes, 16: 26200 (ORNL-3287)
Neutron poisons as criticality control, 16: 25415 (ORNL-3309)
Optical emission from irradiated metallic foils, 16: 25847 (ORNL-3114)
Oxygen solubility in water and thoria slurries, 16: 25324 (TID-16392)
Personnel-exposure and contamination control in operation of research reactors, 16: 25654 (ORNL-TM-278)
Preparation of high-purity BeO, 16: 26481 (TID-7622(p.122-7))
Prog. rpt. on geologic aspects of Th recovery, 16: 25618 (TID-15225)
Prog. rpt. on organic liquid radiation stability, 16: 25420 (SRIA-62)
Program for analysis of kinetics of MSRE, 16: 26619 (ORNL-TM-203 (Add.))
Radiation effects on thoria–urania slurries, 16: 26494 (TID-7622(p.282-99))
Radiation-induced sintering of ThO_2, 16: 25848 (ORNL-3275)
Release of fission products on in-pile melting of reactor fuels, 16: 26488 (TID-7622(p.207-15))
Separation of transplutonium elements, 16: 25477 (ORNL-3273)
Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
Visco seal, survey, 16: 25506 (TID-15987)
Zircaloy properties relevant to reactor design, 16: 25760 (ORNL-3281)
OFFICE OF TECHNICAL SERVICES, WASHINGTON, D. C.
Bibliography on food preservation by irradiation, 16: 25685 (SB-403(Rev.))
OHIO STATE UNIV., COLUMBUS.
Uranium oxide pressure-temperature-composition relationships, 16: 26483 (TID-7622(p.139-48))
OHIO STATE UNIV. RESEARCH FOUNDATION, COLUMBUS.
Electromagnetic waves in longitudinally magnetized ferrites, 16: 26399 (AD-270635)
OWENS-CORNING FIBERGLAS CORP. TECHNICAL CENTER, GRANVILLE, OHIO.
Nuclear fuel-bearing glasses, 16: 26477 (TID-7622(p.74-85))

P

PARIS. UNIVERSITÉ.
Chemical properties of elements in molten LiCl, 16: 25306 (CEA-2125)
PARSONS (C. A.) AND CO., LTD., NEWCASTLE-UPON-TYNE, ENGLAND.
Bibliography on fuel cells, 16: 25915 (NP-11936)
PAVIA, ITALY. UNIVERSITÀ.
Conductivity in plastically deformed alkali halides, 16: 25316 (NP-11921)
PENNSYLVANIA STATE UNIV., UNIVERSITY PARK.
Prog. rpt. on radiation effects on polymers, 16: 25853 (TID-16273)
PERKIN-ELMER CORP., NORWALK, CONN.
Blood cell scanner, 16: 25568 (NYO-9644)
PHILADELPHIA GENERAL HOSPITAL.
Prog. rpt. on effects of x rays on lipids of skin, 16: 25178 (TID-16131)
PHILLIPS PETROLEUM CO. ATOMIC ENERGY DIV., IDAHO FALLS, IDAHO.
Data analysis for scintillation spectrometry, 16: 25556 (IDO-16784)
Generation of time distributed random pulses, 16: 25555 (IDO-16783)
Kinetic effects of scram rods, 16: 26468 (IDO-16777)
PICATINNY ARSENAL, DOVER, N. J.
Ordnance materiel exposed to atomic bomb detonation, 16: 25088 (PA-TR-1690)
PISA, ITALY. UNIVERSITÀ.
Computer program for analysis of bubble chamber photographs, 16: 25904 (LNF-62/37(p.157-8))
Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
POLAND. BIURO PELNOMOCNIKA RZADU DO SPRAW WYKORZYSTANIA ENERGII JADROWEJ. CENTRALNE LABORATORIUM OCHRONY RADIOLOGICZNEJ, WARSAW.
Latent image fading in film emulsions, 16: 25645 (CLOR-11)
Plants as radioactive monitors, 16: 25644 (CLOR-9)
POLISH ACADEMY OF SCIENCES. INST. OF NUCLEAR RESEARCH. WARSAW.
Apparatus for processing nuclear emulsions, 16: 25504 (PAN-293/I-A)
Diffraction scattering of deuterons. II., 16: 26228 (PAN-300/VII)
Green functions of transport equation, 16: 26201 (PAN-284/IX)
Hot atom chemistry of halogens. II., 16: 25417 (PAN-302/V)
Influence of diluent on extraction of Fe(III), 16: 25481 (PAN-303/V)
Magnetic fields for plasma research, 16: 26403 (PAN-301/XVIII)
Nuclear physics in Warsaw, 16: 25950 (PAN-279/I-A)
Optical model potential, 16: 26229 (PAN-304/VII)
Properties of Ge bombarded with neutrons, 16: 25851 (PAN-316/I-B)
Radiation damage for study of properties of Ge, 16: 25849 (PAN-314/I-B)
Radiation yield of hydrogen in deaerated "Neda," 16: 25416 (PAN-289/ChR)
Scattering of holes in Ge by fast neutrons, 16: 25850 (PAN-315/I-B)

Synergetic effects on Pu extraction systems, 16: 25480 (PAN-270/V)
Thermoelectric power of Ge bombarded by fast neutrons, 16: 25852 (PAN-318/I-B)

PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP., HARTFORD, CONN.
Prog. rpt. on emissivity of materials, 16: 25761 (PWA-2088)

PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP. CONNECTICUT AIRCRAFT NUCLEAR ENGINE LAB., MIDDLETOWN.
Helium generation and release in irradiated BeO, 16: 26492 (TID-7622 (p.254-62))

PRINCETON UNIV., N. J.
Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)

PURDUE RESEARCH FOUNDATION, LAFAYETTE, IND.
Oxidation and stoichiometry of Pr and Ce oxides, 16: 25315 (NP-11758)
Prog. rpt. on nuclear physics, 16: 25953 (TID-16079)

R

RADIATION APPLICATIONS INC., LONG ISLAND CITY, N. Y.
Prog. rpt. on radiation-induced gelation, 16: 25418 (RAI-306)

RADIO CORP. OF AMERICA. AEROSPACE COMMUNICATIONS AND CONTROLS DIV., CAMDEN, N. J.
Digital transducers, 16: 25565 (NP-11860)
Hyper-temperature sensors for nuclear rocket reactors, 16: 26630 (NP-11861)

RADIO CORP. OF AMERICA. ASTRO-ELECTRONICS DIV., PRINCETON, N. J.
Solar cell array optimization, 16: 25080 (ASD-TR-61-11(Vol.I))

RAND CORP., SANTA MONICA, CALIF.
Critical dimensions of reactors, 16: 26064 (RM-2917-PR)
Inference of Monte Carlo properties, 16: 25690 (RM-3184-PR)
Minsk conference on heat and mass transfer, 16: 25527 (RM-2852-PR)
Solar flares and space flight, 16: 26631 (RM-2825-PR)

RESEARCH TRIANGLE INST., DURHAM, N. C.
Prog. rpt. on anti-radiation compounds, 16: 25249 (NP-11740)

REYNOLDS ELECTRICAL AND ENGINEERING CO., INC. RADIOLOGICAL SAFETY DIV., MERCURY, NEV.
Kiwi, on-site rad-safe, 16: 25655 (TID-14960)

RIAS. DIV. OF MARTIN CO., BALTIMORE.
Dilation parameters in martensitic transformation, 16: 25763 (TID-16191)

RICE UNIV., HOUSTON, TEX.
Prog. rpt. on geologic aspects of Th recovery, 16: 25618 (TID-15225)

ROCHESTER, N. Y. UNIV.
Hyperon-nucleon scattering, 16: 26091 (NYO-10234)
Polarization of 7-8 Mev protons scattered from Ni-58 and Ti-48, 16: 26226 (NYO-10131)
Spurious scattering in nuclear emulsions, 16: 26090 (NYO-10235)

ROCHESTER, N. Y. UNIV. ATOMIC ENERGY PROJECT.
Changes in pigeon following inhalation of Hg vapor, 16: 25154 (UR-578)

ROME. UNIVERSITÀ.
Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))

ROSCOE B. JACKSON MEMORIAL LAB., BAR HARBOR, ME.
Prog. rpt. on population genetics of irradiated mice, 16: 25182 (TID-16323)

ROSWELL PARK MEMORIAL INST., BUFFALO.
Prog. rpt. on tumor localization and organ visualization studies, 16: 25097 (TID-16081)

RUTGERS UNIV., NEW BRUNSWICK, N. J.
Prog. rpt. on inorganic amphipathic compounds, 16: 25317 (NYO-9837)

S

SAINT OLAF COLL., NORTHFIELD, MINN.
Stripping film in autoradiography, 16: 25508 (TID-16158)

SANDIA CORP., ALBUQUERQUE, N. MEX.
Airborne contamination control, 16: 25509 (TID-16274)
Apparatus for measuring electrical resistance, 16: 25769 (SCL-T-434)

SCHOOL OF AEROSPACE MEDICINE, BROOKS AFB, TEX.
Radiobiologic experiments in Discoverer satellite XVIII, 16: 25[illegible]3 (NP-11784)

SOUTHERN RESEARCH INST., BIRMINGHAM, ALA.
Surface tension of fused salts, 16: 26482 (TID-7622(p.128-36))

SOUTHWEST RESEARCH INST., SAN ANTONIO.
Sea disposal containers, 16: 26641 (TID-15431)

SPAIN. JUNTA DE ENERGÍA NUCLEAR, MADRID.
Description of JEN-1 Reactor, 16: 26617 (JEN-97-DF/I-30)
Design of exponential experiment, 16: 26469 (JEN-89-DF/I-28)
Organic moderators and coolants, 16: 25312 (JEN-90-DQ/I-24)

STANFORD RESEARCH INST., MENLO PARK, CALIF.
Prog. rpt. on organic liquid radiation stability, 16: 25420 (SRIA-62)

STANRAY CORP., CHICAGO.
Prog. rpt. on spent fuel shipping, 16: 25647 (EURAEC-164)

STOCKHOLM. UNIV.
Prog. rpt. on H-3 in atmosphere, rainwater, and sea, 16: 25619 (TID-16272)

SWEDEN. KUNGLIGA VETENSKAPSAKADEMIEN. GEOFYSISKA OBSERVATORIET, KIRUNA.
Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)

SWITZERLAND. EIDGENÖSSISCHES INSTITUT FÜR REAKTORFORSCHUNG, WÜRENLINGEN.
Treatment of liquid waste at Wurenlingen, 16: 26635 (EIR-24)

SYLVANIA-CORNING NUCLEAR CORP., BAYSIDE, N. Y.
Evaluation of UO_2–stainless steel core materials, 16: 25762 (SCNC-264)

SYRACUSE UNIV., N. Y.
Equipment for low-cycle fatigue tests, 16: 25606 (TID-15356)

T

TAPCO. DIV. OF THOMPSON RAMO WOOLDRIDGE INC., CLEVELAND.
Corrosion resistances of metallic materials to LiH, 16: 25718 (NP-11952)

TENNESSEE. UNIV., KNOXVILLE.
Coulomb excitation with heavy ions, 16: 26230 (TID-16058)
Kinetics of uranyl sulfate exchange, 16: 25478 (ORNL-3296)
Labyrinth seal; theory and design, 16: 25505 (TID-15986)
Mechanical face seal, sealing theory, 16: 25507 (TID-15988)
Visco seal, survey, 16: 25506 (TID-15987)

TEXAS NUCLEAR CORP., AUSTIN, TEX.
Neutron-gamma spectrometer, 16: 25549 (ASD-TDR-62-52)

U

UNION CARBIDE NUCLEAR CO. PADUCAH PLANT, KY.
Environmental monitoring, 16: 25653 (KY-419)
Fluorine cell research facility, 16: 25314 (KY-399)

UNION CARBIDE NUCLEAR CO. Y-12 PLANT, OAK RIDGE, TENN.
Determination of Na and K in Be, 16: 25274 (Y-1394)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY, LONDON.
Fuel elements for power reactors, 16: 26610
Nuclear power in Britain, 1962, 16: 25082 (DPR/INF/267)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. INDUSTRIAL GROUP. DOUNREAY EXPERIMENTAL REACTOR ESTABLISHMENT, CAITHNESS, SCOTLAND.
Impurities in liquid metal coolant and their effect on Nb and V, 16: 26475 (TID-7622(p.35-56))
Preliminary work on Mo species in nitric acid, 16: 25311 (IG-Memo-466)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. PRODUCTION GROUP, SPRINGFIELDS, LANCS, ENGLAND.
Determination of sulfate in uranyl nitrate liquors, 16: 25270 (PG-Report-330)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. REACTOR GROUP, DOUNREAY, CAITHNESS, SCOTLAND.
Nuclear heating of non-fissile material, 16: 26231 (TRG-Report-322)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. REACTOR GROUP. ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET, ENGLAND.
Cocurrent annular flow in vertical pipe, 16: 25518 (AEEW-R-142)
Computer procedure for synthesizing control systems, 16: 26454 (AEEW-R-156)
Derivation of system transfer function, 16: 25543 (AEEW-R-154)
Emergency air sampling, 16: 25542 (AEEW-R-150)
Neutron attenuation in Fe–H_2O shields, 16: 26192 (AEEW-R-125)
Pulse fission counters, 16: 25541 (AEEW-R-107)

UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP.

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, BERKS, ENGLAND.
Carbon transport in GCR, 16: 26473 (TID-7622(p.1-23))
Cesium separation. III., 16: 25472 (AERE-R-4039)
Doppler broadening of slow neutron resonances, 16: 26214 (AERE-M-1035)
Fundamentals of film dosimetry, 16: 25658 (AERE-Trans-895)
Irradiation experiments with PuO_2 and ThO_2 - UO_2, 16: 26493 (TID-7622(p.263-81))
Liquid film and pressure drop studies in annular two-phase flow, 16: 25520 (AERE-R-3921)
Pressure drop for flow of steam/water mixtures, 16: 25519 (AERE-R-3808)
Radiation-induced oxidation of hydrocarbons, 16: 25424 (AERE-Trans-894)
UNITED NUCLEAR CORP. DEVELOPMENT DIV., WHITE PLAINS, N. Y.
Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
UNITED STATES–EURATOM JOINT RESEARCH AND DEVELOPMENT PROGRAM.
Prog. rpt. on CAN-1, 16: 26603 (EURAEC-36)
Prog. rpt. on CAN-1, 16: 26604 (EURAEC-38)
Prog. rpt. on fission-product release from claddings, 16: 25750 (BMI-X-196)
Prog. rpt. on Nb-base alloys, 16: 25695 (BMI-X-188)
Prog. rpt. on reactor fuel management, 16: 26464 (EURAEC-255)
Prog. rpt. on spent fuel shipping, 16: 25647 (EURAEC-164)
Prog. rpt. on UN, 16: 25839 (BMI-X-197)
Prog. rpt. on waste disposal, 16: 26636 (EURAEC-84)
Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
UPPSALA UNIV.
Prog. rpt. on radiation effects on human cells, 16: 25181 (TID-16317)
UTAH. UNIV., SALT LAKE CITY.
Determination of appearance potentials, 16: 25320 (TID-16157)
Oxygen solubility in water and thoria slurries, 16: 25324 (TID-16392)
Transient electrode potentials of Ni, 16: 25322 (TID-16292)

V

VIDYA, INC., PALO ALTO, CALIF.
High-temperature transport coefficients of gases, 16: 25880 (ARL-62-328)
Thermodynamic properties of gases, 16: 25300 (ARL-62-358)
VIRGINIA. AGRICULTURAL EXPERIMENT STATION, BLACKSBURG.
Estimation of strength of radioactive source, 16: 25548 (AROD-2763:9)

W

WABASH COLL., CRAWFORDSVILLE, IND.
Prog. rpt. on movement of Rb-86 and P-32 in forest, 16: 25150 (TID-15963)
WASHINGTON. UNIV., SEATTLE.
Scintillation crystals for neutron dosimetry, 16: 25570 (TID-16107)
WATERTOWN ARSENAL, MASS.
Analysis of Ti and Ti alloys, 16: 25269 (NP-11834)
WESTFIELD COLL., LONDON.
Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
WESTINGHOUSE ELECTRIC CORP., CHESWICK, PENNA.
Sodium flow controller, 16: 25569 (TID-15915)
WESTINGHOUSE ELECTRIC CORP., LIMA, OHIO.
Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DEPT., PITTSBURGH.
Design of CVTR pressure tube, 16: 26585 (CVNA-95)
WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DIV., PITTSBURGH.
Computer analysis of loss-of-coolant accident, 16: 26587 (CVNA-117 (Vol.I))
Computer analysis of loss-of-coolant accident. II., 16: 26588 (CVNA-117(Vol.II))
Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
Development of the CVTR moderator tank, 16: 26586 (CVNA-108)
Prog. rpt. on CVTR project, 16: 26600 (WCAP-4126)
Prog. rpt. on neutron detector, 16: 25573 (WCAP-1989)
WESTINGHOUSE ELECTRIC CORP. BETTIS ATOMIC POWER LAB., PITTSBURGH.
Basic parameters in two phase annular flow, 16: 25528 (WAPD-T-1502)
Block iterative methods for two-cyclic matrix equations, 16: 25691 (WAPD-TM-327)
Fission product activity levels in primary coolant of PWR, 16: 26599 (WAPD-PWR-TE-79)
Properties of Hf from PWR control rod, 16: 25854 (WAPD-TM-336)
Study of UO_2–ZrO_2 system, 16: 25765 (WAPD-253)
WORCESTER FOUNDATION FOR EXPERIMENTAL BIOLOGY, SHREWSBURY, MASS.
Prog. rpt. on biologically active amines, 16: 25176 (TID-16113)
WORLD METEOROLOGICAL ORGANIZATION, GENEVA.
Meteorological aspects of safety and location of reactor plants, 16: 25615 (NP-11760)

Y

YALE UNIV., NEW HAVEN.
Detection of twenty positron-emitting sources, 16: 25571 (TID-16268)
Radiation laws, 16: 25879 (ARL-62-320)

PERSONAL AUTHOR INDEX

Each entry after an author's name is a shortened version of the title of the report or article, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt." This change permits a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Ä	becomes	ae
Ö		oe
ø		oe
Ü		ue (except in transliterated Chinese names)

A

AARKROG, A., Environmental radioactivity in Denmark, 1961, 16: 25169 (RISÖ-41)

ABBINK, Janet E., Separation of V, 16: 25484 (IS-415)

ABDON, R., Stability of fast reactors, 16: 26559

ABECASIS, S., Yield ration for isomeric pair Te-121m, Te-121, 16: 26240

ABKIN, A. D., Mechanism of radiation polymerization. I., 16: 25457

ABKIN, A. D., Mechanism of radiation polymerization. II., 16: 25458

ABRAHAMSON, E. P., II., Recrystallization in Ni, 16: 25822

ABRAMOV, A. I., Physical characteristics of the BR-5, 16: 26567

ABRAMOV, A. I., Recording neutron spectra of fast reactors, 16: 26204 (AEC-tr-5217)

ABRAMS, Charles S., Adsorption of U, 16: 25465 (ACCO-26)

ACKERMANN, R. J., Thermodynamic properties of compounds of actinide elements, 16: 25398

ACKERMANN, R. J., Vaporization properties of Th, U, and Pu metals and oxides, 16: 25400

ADAM, J., Direct conversion of fission heat to electric power, 16: 25972

ADAM, J. P., Radiative disintegration of pions, 16: 26113

ADAMOV, V. M., Kinetic energy of fragments emitted in fission of U-238, 16: 26355

ADAMS, C. E., Vapor pressures in Rb_2O–B_2O_3, 16: 25325 (USNRDL-TR-566)

ADAMS, W. M., Shotpoint medium and seismic coupling, 16: 25632

ADAMS, William M., Seismic decoupling for explosions, 16: 25633 (UCRL-6086)

ADDISON, C. C., Liquid metals. V., 16: 25782

ADDISS, R. R., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))

ADKINS, C. J., Energy gap in superconducting Sn, 16: 26010

ADLER, George, Polymerization of ethylene by γ rays, 16: 25409 (BNL-740)

AEBERHARDT, A., Biological study of luminous paint, 16: 25110 (CEA-2155)

AFANAS'EV (AFANAS'YEV), I. I., Mass-spectrometer for investigating ion sources, 16: 26390 (FTD-TT-61-242(p.162-6))

AFRICAN, J. S., Solvent extraction in U industry, 16: 25490

AGENO, M., Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))

AGENO, M., Measurement of mean life of π mesons, 16: 25901 (LNF-62/37 (p.118-38))

AGENO, M., Research program with "light" of Frascati synchrotron, 16: 25903 (LNF-62/37(p.142-56))

AHLERS, Gordon K., Design of Al structure, 16: 25705 (BNL-4932)

AHLUWALIA, H. S., Diurnal variation of cosmic radiation, 16: 26059

AHRENS, L. H., Scandium, Y, Nd, Ce, and La silicate rocks, 16: 25287

AINUTDINOV, M. S., Elastic scattering of 7.2-Bev π^- mesons on protons, 16: 26180

AITKEN, E. A., Formation of $UO_{2.00}$-$6YO_{1.5}$, 16: 25350

AITKEN, E. A., Oxidation of Be intermetallic compounds, 16: 25723

AITKEN, E. A., Recoil loss from ceramic fuel elements, 16: 26487 (TID-7622(p.193-206))

AKACHINSKII, V. V., Heat of formation of compounds of Pu with Al and Fe and of U with Fe, 16: 25834

AKAGI, E., Hemolytic substance produced after irradiation. II., 16: 25226

AKAGI, E., Hemolytic substance produced after irradiation. I., 16: 25227

AKAISHI, Jun, Bibliography on analysis of urine for radionuclides, 16: 25268 (JAERI-4020)

AKIBA, T., S-wave $\bar{K}$-N scattering amplitudes, 16: 26137

ALBERIGI, A., Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37(p.105-9))

ALCOCK, C. B., Study of U borides and carbides by Knudsen effusion technique, 16: 25375

ALEKSANDOVSKAYA, M. M., Changes in nervous system in irradiated rats, 16: 25246

ALEXANDER, Carl A., Uranium oxide pressure-temperature-composition relationships, 16: 26483 (TID-7622(p.139-48))

ALEXANDER, Gideon, Strange-particle resonant states, 16: 26134

ALEXANDER, Gideon, Three-body decays of neutral K mesons, 16: 26151

ALFERT, Max, Chromosome breakage by x rays, 16: 25217

ALFORD, W. Parker, Polarization of 7-8 Mev protons scattered from Ni-58 Ti-48, 16: 26226 (NYO-10131)

ALFORD, W. Parker, Protons scattered from Ni-58 and Ti-48, 16: 26290

ALI, M. I., Dispersion relations applied to π^--p scattering, 16: 26123

ALLEN, DeWitt C., Seismic decoupling for explosions, 16: 25633 (UCRL-6086)

ALLEN, J. S., Transistorized voltage control for magnet, 16: 25566 (NP-11883)

ALLEN, Robert D., Thermal expansion of synthetic graphites, 16: 25773

ALLISON, Samuel K., Electron capture and ions, 16: 26043

ALMAZOVA, S. P., Recording of nuclear fission fragments, 16: 25558 (JINR-P-979)

ALMEIDA, Silverio P., Three-body decays of neutral K mesons, 16: 26151

ALTER, H. W., Plutonium fuel processing and fabrication, 16: 25697 (GEAP-3876)

ALYAMOVSKII, V. N., Distribution functions of electric microfield in ionized gas, 16: 26429

AMALDI, E., Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))

AMALDI, E., Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))

AMATEAU, M. F., Effect of molten alkali metals on containment metals, 16: 25714 (DMIC-169)

AMATI, D., Asymptotic properties of scattering, 16: 26116

AMELINCKX, S., Dislocations and fission damage in Pt, 16: 25863
AMES, L. L., Thermodynamics of vaporization of rare earth oxides, 16: 25386
AMINO, S., Radiation cancer, 16: 25201
AMINO, S., Variations of unsaturation of lipids in serum, 16: 25229
AMNOFF, G., Crystal structure of BeO, 16: 25770 (UCRL-Trans-826(L))
AMMAN, F., Construction of storage rings, 16: 25905 (LNF-62/37(p.161-5))
AMMAN, F., Elements of plan of 10-Bev electron synchrotron, 16: 25929 (NP-11977(p.78-80))
AMMAN, F., Storage ring for electrons and positrons (Adone), 16: 25930 (NP-11977(p.80-8))
ANDRIENKO, V. M., Vapor pressure of U compounds, 16: 25371
ANDRAR, M., Chemical behavior of F-18, 16: 25432
ANCHUTIN, A., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
ANCKER-JOHNSON, Betsy, Plasmas in InSb in magnetic fields, 16: 26400 (DI-82-0172)
ANDERS, E., Abundances of I, Te, and U in meteorites, 16: 25623
ANDERSEN, A. C., Prog. rpt. on Sr-90 ingestion, 16: 25153 (UCD-106)
ANDERSEN, A. C., Prog. rpt. on effects of radiation on dog, 16: 25183 (UCD-105)
ANDERSON, E. E., Fission product retention studies of graphite reactor fuels, 16: 26486 (TID-7622(p.171-92))
ANDERSON, E. E., Release of K and Xe fission products from (U,Th)C_2–graphite fuel matrix, 16: 25752 (GA-3211)
ANDERSON, J. D., Isobaric states in nonmirror nuclei, 16: 26326 (UCRL-6733)
ANDERSON, J. D., Isobaric states in medium-A nuclei, 16: 26333 (UCRL-6830)
ANDERSON, R. W., Prog. rpt. on power reactors, 16: 25735 (NMI-7251)
ANDERSON, R. W., Prog. rpt. on solubility of gases in Be, 16: 25757 (NMI-9815)
ANDREEV, P. F., Interaction of uranyl salts with chitin, 16: 25487
ANDREEVA, O. S., Industrial hygiene in handling U and its compounds, 16: 25678
ANDREWS, Giles J., Scintillation scanning of the liver. II., 16: 25099
ANDREWS, H. N., Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
ANDRONOV, A. A., Attenuation and growth of plasma waves, 16: 25961 (JPRS-13656(p.164-76))
ANGERMAN, C. L., Studies of Al–Ni–U bonds, 16: 25817
AQUINO, R. T., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
ARABIAN, Robert V., Prog. rpt. on Rb corrosion, 16: 25712 (AGN-8051)
ARAI, T., Lung injuries following x-ray treatment, 16: 25160
ARAKAWA, E. T., Optical emission from irradiated metallic foils, 16: 25847 (ORNL-3114)
ARAKAWA, E. T., Optical emission from irradiated foils. II., 16: 26315
ARGAN, P. E., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
ARGAN, P. E., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
ARIGA, K., Mechanism of ultrasonic therapy, 16: 25219
ARMITAGE, B. H., Energy levels of B-10. I., 16: 26265
ARMSTRONG, F. W., Arc welding of nuclear components, 16: 25740
ARMSTRONG, R. D., Changes in pigeon following inhalation of Hg vapor, 16: 25134 (UR-578)
ARNELL, S. E., Radiative proton capture by Cr-50, Cr-52, Cr-53, and Cr-54, 16: 26235
ARNOLD, Frederick, Labyrinth seal; theory and design, 16: 25505 (TID-15986)
ARONOFF, S., Non-exchangeability of Mg-28 with chlorophyll a, 16: 25155
ARTYUKHINA, N. I., Change in nervous system in rats exposed to x radiation, 16: 25245
ARUMACHALAM, V. S., Lattice strains in β-quenched U, 16: 25788
ASAMI, Tetsuo, JAERI neutron crystal spectrometer, 16: 25557 (JAERI-1030)
ASCARI, A., Facilities of Avogadro RSI reactor, 16: 26625
ASCOLI, G., Electrostatic instability of particles penetrating a plasma, 16: 26397 (AD-269051)
ASHE, J. B., Neutron-gamma spectrometer, 16: 25549 (ASD-TDR-62-52)
ASHMORE, A., Pion-nucleon coupling constant, 16: 26105
ASKARYAN, G. A., Effect of gradient of EM ray on electrons and atoms, 16: 26183
ASKWYTH, W. H., Prog. rpt. on emissivity of materials, 16: 25761 (PWA-2088)
ASPLUND, I., Absolute measurement of p of Cf-252, 16: 26515
ASUNDI, M. K., Lattice strains in β-quenched U, 16: 25788
ATEN, A. H. W., Jr., Neutron-irradiated Cl oxyanions, 16: 25444
ATWOOD, Donald K., Electrode potential of Rn(IV), 16: 25343
AUKRUST, E., Equilibrium measurements in UO_{2+x}, 16: 25373
AUSLOOS, P., Gas-phase radiolysis of propene, 16: 25434
AUSTIN, Jere C., Bibliography on γ radiography, 16: 25604 (BNL-716)
A-U-ZAMAN, ρ-particle contribution to π-N scattering, 16: 26114
AVANZI, S., Effects of radiation on wheat, 16: 25194 (CNEN-124)
AVERBACH, B. L., Atomic arrangements in Ti–Mo, 16: 25772 (NYO-7062)
AVERY, A. F., Neutron attenuation in Fe–H_2O shields, 16: 26192 (AEEW-R-125)
AVERY, R., Coupled fast-thermal steam superheating reactor, 16: 26553
AWAD, A. M., Uranyl azide complexes, 16: 25352

B

BABERKIN, A. S., Effects of γ rays on guanidinium Al sulfate, 16: 25456
BABIKOV, V. V., Gamma radiation from compound nucleus, 16: 26364
BABUSHKIN, F. A., Correction to finite nuclear size in isotopic shift, 16: 26360
BACHER, P., Physics experiments in graphite lattices, 16: 26063 (CEA-2157)
BACIC, Iva, Structure of H_2O and H_2O solutions, 16: 25327 (AEC-tr-5126)
BACK, R. A., Reactions of N with $N^{15}O$ and N_2^{15}, 16: 25362
BAERTSCHI, P., Treatment of liquid waste at Würenlingen, 16: 26635 (EIR-24)
BAGARYATSKII, Yu. A., Phases in Ni–Be and Cu–Be, 16: 25810
BAGGIO, P., Mineralization of U, 16: 25634 (CNEN-53)
BAILYN, M., Conduction problems in a magnetic field, 16: 25988
BAIN, E. C., Effects of Nb on steel, 16: 25811
BAIR, W. J., Effectiveness of I-127 as diluent of I-131 aerosol, 16: 25123 (HW-72500(p.52-5))
BAIR, W. J., Inhalation of dust containing Np-237, 16: 25124 (HW-72500 (p.56-60))
BAIR, W. J., Removing inhaled radioactive particles, 16: 25127 (HW-72500 (p.74-6))
BAIR, W. J., Retention, translocation, and excretion of inhaled Pu, 16: 25125 (HW-72500(p.61-6))
BAKAKIN, V. V., Crystal chemistry of beryl, 16: 25628
BAKER, A. R., Results with metallic and ceramic fuels, 16: 26524
BAKER, F. S., Production of H^+ from H_2, 16: 25955 (UCRL-6925)
BAKER, George A., Jr., Models in limit of long-range interactions, 16: 26125
BAKER, R. A., Heat transfer in Na–K alloy, 16: 25535
BAKER, R. C., Environmental monitoring, 16: 25653 (KY-419)
BAKER, T. W., Lattice parameter and density of BeO, 16: 25783 (AERE-R-3774)
BAKH, N. A., X-ray-induced polymerization of acetaldehyde, 16: 25461
BALACHANDRAN, A. P., On Y^* resonances, 16: 26111
BALACHANDRAN, A. P., Partial wave dispersion relations for Λ-N scattering, 16: 26110
BALANDIN, A. A., Radiolysis of Rb compounds, 16: 25430
BALCARCZYK, L., Research reactor Astra, 16: 26623
BALDASSARE, F., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
BALESCU, R., Some aspects of irreversible thermodynamics, 16: 25382
BALKANSKI, M., Phonon absorption bands in fast-neutron-irradiated Si, 16: 25866
BALL, G. L., Group cross sections for fast reactors, 16: 26519
BALL, J. B., KINEMATICS II—nonrelativistic Fortran program, 16: 26227 (ORNL-3251)
BALLARDIN, E., Sensitivity to x rays of *Artemia salina* leach, 16: 25198 (CNEN-117)
BALLIS, G. W., Concurrent annular flow in vertical pipe, 16: 25518 (AEEW-R-142)
BALLOU, J. E., Metabolism of Np, 16: 25120 (HW-72500(p.41-3))
BALLOU, J. E., Removal of internally deposited Pu, 16: 25128 (HW-

72500(p.77-80))
BALLUFFI, R. W., Point defects in deformed f.c.c. metals, 16: 25764 (TID-16222)
BALZHISER, R. E., Thermodynamics of U–Bi system, 16: 25387
BALZHISER, Richard E., Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
BANET, L., Prog. rpt. on thermal radiation studies, 16: 25876 (AFSWP-844)
BANUS, M. D., Superconducting Nb_3In, 16: 25803
BARAD, Morton L., Green Glow diffusion program, 16: 25612 (HW-71400 (Vol.I))
BARANGER, M., Spectral line broadening in plasmas, 16: 26037
BARANOV, V. I., Geochemistry of U and Th, 16: 25627
BARASHENKOV, V. S., Interactions of particles at high energies, 16: 26071 (JINR-P-817)
BARBARO-GALTIERI, Angelo, Leptonic Σ^+ decay, 16: 26143
BARBASHOV, B. M., Non-renormalization theories, 16: 26079 (JINR-P-964)
BARBER, D. A., Effect of DNP on Ca accumulation and transpiration, 16: 25140 (HW-72500(p.128-33))
BARBER, D. A., Uptake of arsenate by barley plants, 16: 25138 (HW-72500(p.119-22))
BARBER, R. C., Mass differences between Sn isotopes, 16: 26335
BARBIELLINI, G., Bremsstrahlung intensity from electron synchrotron, 16: 26136
BARBIELLINI, G., Polarized photon beam from Frascati synchrotron, 16: 25932 (NP-11977(p.93-4))
BARBIERI, W., Determination of rare earths in U compounds, 16: 25266 (CNEN-135)
BARFIELD, Ariel F., Determination of appearance potentials, 16: 25320 (TID-16157)
BARGHUSEN, John J., Dissolving U–Zr, 16: 25710
BARIGOZZI, C., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
BARIGOZZI, C., Sensitivity to x rays of *Artemia salina* leach, 16: 25198 (CNEN-117)
BARJON, Robert, Scattering of neutrons by C, 16: 26288
BARKAS, Walter H., Leptonic Σ^+ decay, 16: 26143
BARLOUTAUD, R., π^+-p elastic scattering, 16: 26120
BARNES, D. W., High-temperature heat contents of refractory borides, 16: 25401
BARNES, R. H., Xenon-133 diffusion in alumina, 16: 26491 (TID-7622 (p.245-53))
BARR, T. A., Jr., Design of ARGMA 8,000-kw plasma facility, 16: 25499 (ARGMA-TN-2H5N)
BARRINGER, R. E., Determination of Na and K in Be, 16: 25274 (Y-1394)
BARSOVA, L. I., Radiolysis of Rh compounds, 16: 25490
BARTECKI, Adam, Hungarian science in field of spectroscopy, 16: 25091
BARTELL, L. S., Isotope effects in molecular structure, 16: 25348 (IS-454)
BARTENBACH, Maria, Radiation damage for study of properties of Ge, 16: 25849 (PAN-314/I-B)
BARTENBACH, Maria, Thermoelectric power of Ge bombarded by fast neutrons, 16: 25852 (PAN-318/I-B)
BARTS, E. W., Accident analyses for fast assemblies, 16: 26565
BASHAW, R. H., Radiation-induced cronslinking, 16: 25446
BASIL, Helen, Spark counters with plane-parallel electrodes, 16: 25575 (AEC-tr-5239)
BASSET, Jacques, Ultra pressures, 16: 25515 (NP-tr-892)
BASSETTI, M., Construction of storage rings, 16: 25905 (LNF-62/37 (p.161-5))
BATCHELOR, R., Fast-neutron data and fast-neutron cross-section measuring, 16: 26504
BATES, D. R., Atomic and molecular processes, 16: 26024
BATES, D. R., Collisions between atomic systems, 16: 26038
BATES, D. R., Electronic recombination, 16: 26031
BATTAT, M. E., Critical experiments and nuclear calculations, 16: 26523
BATZER, Thomas H., Renewable liquid gettering pump, 16: 25603
BAUER, Arthur A., Prog. rpt. on Nb-base alloys, 16: 25695 (BMI-X-188)
BAUER, Arthur A., Prog. rpt. on fission-product release from claddings, 16: 25750 (BMI-X-196)
BAULCH, D. L., Beta recoil from solid surfaces, 16: 26009
BAUMAN, H. F., Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
BAYBARZ, R. D., Separation of transplutonium elements, 16: 25477 (ORNL-3273)
BAYLY, J. G., Fog density measurement, 16: 25551 (CRRP-1086)
BEALE, Robert J., Nuclear-electric spacebus, 16: 26628 (JPL-TR-32-231)
BEAN, K. E., Purification of CdS crystals, 16: 25878 (ARL-62-319)
BEATTIE, J. W., Production and properties of high-energy electrons, 16: 25188
BEAUDRY, B. J., Allotropy of Sc, 16: 25824 (IS-310)
BEAVER, Wallace W., Properties of intermetallic compounds, 16: 25748 (ASD-TDR-62-476)
BECK, Paul A., Specific heat of b.c.c. Ti–V alloys, 16: 25806
BECKER, K., Fundamentals of film dosimetry, 16: 25658 (AERE-Trans-830)
BECKER, K., Photographic film-plate for measuring radiation, 16: 25574 (AEC-tr-5193)
BECKER, L. C., Detection of twenty positron-emitting sources, 16: 25871 (TID-16268)
BEDNAKH, Roman, Green functions of transport equation, 16: 26201 (PAN-284/IX)
BEER, G. A., Lattice measurements with 7-element UO_2 clusters, 16: 26461 (CRRP-1072)
BEG, Mirza A. Baqi, Correspondence between γ and η decays, 16: 26150
BEG, Mirza A. Baqi, Heavy pions and π-N vertex function, 16: 26144
BEKEFI, G., Cyclotron harmonics of a warm plasma, 16: 26418
BELEZNAY, Ferenc, Results of thermonuclear research. II., 16: 26409
BELFORD, Geneva G., Theory of periodic deviations in Schottky effect, 16: 25954 (TID-16225)
BELL, J. S., Elementary theory of weak interactions, 16: 26067 (CERN-62-17)
BELL, M., Elementary theory of weak interactions, 16: 26067 (CERN-62-17)
BELLAMY, B., Lattice parameter and density of BeO, 16: 25783 (AERE-R-3774)
BELLAMY, E. H., Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
BELLAMY, E. H., Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
BELLAMY, E. H., Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
BELLETTINI, G., Coulomb photoproduction of π^0 on nuclei, 16: 25893 (LNF-62/37(p.57-71))
BELLETTINI, G., Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
BELLETTINI, G., Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
BELLETTINI, G., Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
BELLUSCIO, P. R., Changes in pigeon following inhalation of Hg vapor, 16: 25154 (UR-578)
BELOV, N. V., Crystal chemistry of beryl, 16: 25628
BELYAEV, B. N., Production of At-209 and At-207, 16: 26220 (JINR-P-950)
BELYAEV, S. T., Quadrupole oscillations of spherical nuclei, 16: 26389
BEMPORAD, C., Coulomb photoproduction of π^0 on nuclei, 16: 25893 (LNF-62/37(p.57-71))
BEMPORAD, C., Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
BEMPORAD, C., Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
BEMPORAD, C., Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
BENDA, Hansjochen, Volume effect by corrosion of Si single crystal, 16: 25722 (UCRL-Trans-830)
BENDER, M. A., Radiation-induced myeloid leukemias of RF mouse, 16: 25199
BENDISCIOLI, G., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
BENDISCIOLI, G., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
BENEDIKTOVA, G. P., Strength of alloys in contact with Na, 16: 25720 (FTD-TT-61-31(p.41-59))
BENEVENTANO, M., Photoproduction of π^+, 16: 25891 (LNF-62/37 (p.34-9))
BENEVENTANO, M., Photoproduction of pions in H_2 and D_2, 16: 25943 (NP-11977(p.124-6))
BENNETT, Lawrence H., Nuclear moment of Ni-61, 16: 26322
BENSON, P. A., Determination of Fe and U, 16: 25281
BENSON, Royal H., Liquid scintillation counting of H-3, 16: 25429
BENZI, V., Neutron fission product cross sections, 16: 26518
BERARD, Philippe, Handling of PuF_4, 16: 25473 (CEA-2123)
BERDON, Walter, Electron beam 10-35 Mev betatron doses, 16: 25189

BEREZIN, I. V., Reactivity of hydrocarbon during interaction with free methyl radicals, 16: 25335
BERGMANN, C. A., Fission product levels in SM-1 coolant, 16: 26490 (TID-7622(p.236-42))
BERNDE, A., Angular correlations in $S^{32}(p,p'\gamma)$, 16: 26327
BERNDE, A., Scattering of low energy protons on S-32, 16: 26352
BERKOWITZ, Edward H., Gamma rays from Li bombardments of Li, 16: 26325
BERKOWITZ, J., Reaction of graphite with N, 16: 25394
BERKOWITZ, L., Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
BERNARDINI, C., Storage ring for electrons and positrons (Adone), 16: 25930 (NP-11977(p.80-8))
BERNARDINI, M., Construction of storage rings, 16: 25905 (LNF-62/37 (p.161-5))
BERNSTEIN, Bruce S., Prog. rpt. on radiation-induced gelation, 16: 25418 (BAI-306)
BERNSTEIN, S., Fluorine cell research facility, 16: 25314 (KY-399)
BERRY, Warren E., Helium solubility in D_2O, 16: 25303 (BMI-1587)
BERTANZA, L., Decay of negative hyperon, 16: 26141
BERTOLETTI, S., Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
BERZINA, I. G., Contact melting of irradiated crystals, 16: 25868
BHATKI, K. S., Preparation of Tb-161, 16: 25445
BHATTACHARJEE, S. B., Sedimentation studies on DNA from irradiated E. coli, 16: 25218
BHATTACHARYYA, R., Decay of Ag-105, 16: 26295
BIDE, M. G., Reactivity coefficients of Na, 16: 26545
BIALKOWSKI, G., Photoproduction amplitudes of pions on nucleons. II., 16: 26094
BIALYNICKI-BIRULA, I., Gauge conditions in quantum electrodynamics, 16: 25967
BIELAWSKI, Chester A., Properties of intermetallic compounds, 16: 25748 (ASD-TDR-62-476)
BILSTEIN, H., Research reactor Astra, 16: 26623
BIRCH, D., Phase equilibria in U-rich binary alloys, 16: 25785
BIRNHOFF, R. D., Optical emission from irradiated metallic foils, 16: 25847 (ORNL-3114)
BIRNHOFF, R. D., Optical emission from irradiated foils. II., 16: 26315
BISHOP, A. A., Design of CVTR pressure tube, 16: 26585 (CVNA-95)
BISHOP, R. L., Mass differences between Sn isotopes, 16: 26335
BISI, A., Polarization of external bremsstrahlung, 16: 26106
BISI, V., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
BISWAS, N. N., Pion-pion resonance, 16: 26117
BISWAS, S. N., K^+ and $K_{\mu 3}$ decay mode, 16: 26103
BITTEL, R., Fixing of phosphoric ions by Zr—montmorillonite, 16: 25305 (CEA-1650)
BIZZARRI, R., Experiments with β at CERN, 16: 25926 (NP-11977(p.64-5))
BIZZARRI, R., Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
BIZZARRI, R., Use of He bubble chamber, 16: 25925 (NP-11977(p.60-2))
BLAINE, R. A., TYCHE—Monte Carlo slowing down code, 16: 26197 (NAA-SR-7357)
BLAKE, B., Transverse polarization of conversion electrons following β decay, 16: 26086 (NP-11737)
BLAKE, Bernard, Depolarization of transversely polarized electrons, 16: 26178
BLAKELY, J. P., Evolution of gas from graphites, 16: 26474 (TID-7622 (p.24-34))
BLANKENBECLER, R., Photon an elementary particle?, 16: 26139
BLAQUIERE, Augustin, Effect of scintillation of valve auto-oscillators, 16: 25579 (CEA-2028)
BLATON, J., Quadrupole radiation, 16: 26234 (NP-tr-885)
BLATT, John M., Quasi-chemical equilibrium theory, 16: 26012
BLOKH, P. V., Interaction between electron beam and EM waves, 16: 25963 (JPRS-13656(p.193-218))
BLOCH, F. W., Fluorocarbons in reactor technology, 16: 26480 (TID-7622 (p.109-20))
BLOCHER, J. M., Jr., Ceramic-coated nuclear-fuel particles, 16: 26476 (TID-7622(p.57-73))
BLOECHER, F. W., Jr., Elution of U from anion exchange resins, 16: 25463 (ACCO-12)
BLOK, J., Decay of Mn-54, Zn-65, and Co-57, 16: 26336
BLOK, J., Decay of Co-58, 16: 26337
BLOK, J., Fluorescence yield of Cr, Mn, Cu, and Ga, 16: 26000
BLOKHIN, G. E., Pulsed fast reactor, 16: 26570
BLOKHINTSEV, D. I., Pulsed fast reactor, 16: 26570
BLOKHINTSEV, L. D., Analytic properties of nonrelativistic diagrams, 16: 26186
BLUE, E., Diffusion of charged particles in parabolic potential well, 16: 25885 (GEST-2002)
BLUME, M., Spin-lattice relaxation in multilevel spin systems, 16: 25995
BLUMENSTOCK, Jan W., Prog. rpt. on biological aspects of radiation, 16: 25167 (NP-11884)
BLYUMKINA, Yu. A., Pulsed fast reactor, 16: 26570
BOBKER, J., Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
BOBONE, R., Transverse polarization of conversion electrons following β decay, 16: 26086 (NP-11737)
BOCCALETTI, D., Double photoproduction reactions, 16: 25887 (LNF-62/37(p.7-9))
BOCCALETTI, D., Double photoproduction of charged pions, 16: 25942 (NP-11977(p.121-3))
BOCQUET, M., Porous structure of nuclear graphites, 16: 25787
BODINE, M. W., Jr., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
BOEOEK, Jan A., Prog. rpt. on radiation effects on human cells, 16: 25181 (TID-16317)
BOESI, S., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
BOGDANKEVICH, O. V., Splitting of giant resonance in nuclei, 16: 26357
BOGEN, Donald, Plutonium in man, 16: 25171
BOGLE, G. S., Specific heat of Gd sulfates, 16: 25367
BOLIN, Bert, Prog. rpt. on H-3 in atmosphere, rainwater, and sea, 16: 25619 (TID-16272)
BOLOGNA, G., Bremsstrahlung intensity from electron synchrotron, 16: 26136
BOLOGNA, G., Polarized photon beam from Frascati synchrotron, 16: 25932 (NP-11977(p.93-4))
BOLTON, William Kenneth, Fuel elements for reactors, 16: 26573
BONETTI, A., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
BONHAM, Russell A., Inelastic scattering from atoms. I., 16: 26237
BONISSONI, G., Luminescence of alkali halides, 16: 25914 (NP-11920)
BONJOUR, E., Electroconvection effects on heat transfer, 16: 25533
BONNIAUD, R., Vitrification of solutions of fission products, 16: 26634 (CEA-2130)
BONTE, Frederick J., Scintillation scanning of the liver. II., 16: 25099
BONTE, Frederick J., Scintillation scanning of the liver. I., 16: 25098
BOOTH, E. C., Nuclear resonance scattering of bremsstrahlung, 16: 26275
BOOTON, William D., Chromospheric striation obscuration by great flare, 16: 26046 (AFCRL-834)
BOPP, C. D., Nuclear heating in reactor, 16: 26502
BOR, T. P., Extraction system of ion sources, 16: 25577 (NP-tr-902)
BORCSIK, M., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
BORGIA, B., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
BORGIA, B., Photoproduction of π^+ with polarized photons, 16: 25935 (NP-11977(p.99-100))
BORGIA, B., Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
BORGIA, B., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37 (p.76-80))
BORGONOVI, G., Bragg multiple scattering of neutrons, 16: 26211
BORYSOWICZ, Jerzy, Diffraction scattering of deuterons. II., 16: 26228 (PAN-300/VII)
BOS, E. C., Decay of Mn-54, Zn-65, and Co-57, 16: 26336
BOS, E. C., Fluorescence yield of Cr, Mn, Cu, and Ga, 16: 26000
BOST, William E., Bibliography on radioactive fall-out, 16: 25617 (TID-3086 (Suppl. I))
BOTSTEIN, Charles, Electron beam 10-35 Mev betatron doses, 16: 25189
BOUCHER, Rene, Studies on U–Pu–Mo alloys, 16: 25786
BOURGEOIS, P., RACHEL critical assembly, 16: 26527
BOURKE, P. J., Carbon transport in GCR, 16: 26473 (TID-7622(p.1-23))

BOURKE, W., Radiation-induced oxidation of hydrocarbons, 16: 25424 (AERE-Trans-894)
BOURSAT, C., Fixing of phosphoric ions by Zr–montmorillonite, 16: 25305 (CEA-1650)
BOWEN, D. H., Irradiation damage in Be and Mg oxides, 16: 25865
BOWMAN, Harry R., Prompt neutrons from spontaneous fission of Cf-252, 16: 26320 (UCRL-9713(Rev.))
BOWMAN, Kimiko O., Estimation of strength of radioactive source, 16: 25548 (AROD-2763:9)
BOZOKI, G., Inelastic (n,p) cross section, 16: 26252
BOZZINI, A., Mutations induced by ionizing radiation, 16: 25195 (CNEN-126)
BOZZINI, A., Mutations induced by radiation in wheat, 16: 25196 (CNEN-120)
BRACKER, J., Standard molar free energy of formation of some chlorides of Mg, Ce, U, and Th, 16: 25392
BRADLEY, Mildred J., Hydrolysis of U carbides, 16: 25341 (ORNL-TM-38 and Rev.1)
BRADLEY, R. C., Vaporization of impurities in Cu, 16: 25491
BRANDSTETR, I., Determination of Ac-225 and Ac-226 produced in U and Th bombardment, 16: 25411 (JINR-P-978)
BRANNIGAN, Francis L., Nuclear transportation accidents, 16: 25669
BRANSCOMB, L. M., Photodetachment, 16: 26028
BRECKON, D.G., Control and safety in operation of NRX and NRU reactors, 16: 26614 (AECL-1486)
BREWER, D. F., Phase separation of He-4 in He-3, 16: 25976
BRICKLEY, S. G., Mixing velocity in powder mixes, 16: 25512 (NP-tr-887)
BRIGGS, A. H., Entry of Ca-45 in rabbit ventricles, 16: 25107
BRINI, D., Instrumentation for space research, 16: 25588
BRINK, G. O., Production of H^+ from H_2, 16: 25955 (UCRL-6925)
BRISSON, V., Decay of negative hyperon, 16: 26141
BRO, P., Polishing of rare earth tellurides, 16: 25738
BROCKHOUSE, B. N., Acoustical magnons in magnetite, 16: 25979
BRODY, T. A., Studies on radioactive precipitation, 16: 25674
BROPHY, J. H., Joining of refractory metals—W, 16: 25737 (WAL-TR-460.54/1-2)
BROSI, A. R., Polarization of β following P-32 decay, 16: 26259
BROSSMANN, G., Bibliography on hot laboratories, 16: 25500 (KFK-69)
BROWN, Allan, Crystal structures of two Th germanide phases, 16: 25771
BROWN, E. G., Environmental monitoring, 16: 25653 (KY-419)
BROWN, John L., Form factors in $K_{\mu 3}$ and K_{e3} decay, 16: 26135
BROWN, Lawie M., Decay modes of the η meson, 16: 26138
BROWN, P. E., Hyper-temperature sensors for nuclear rocket reactors, 16: 26630 (NP-11861)
BROWN, Paul Erskine, Digital transducers, 16: 25565 (NP-11860)
BROWNING, M. F., Ceramic-coated nuclear-fuel particles, 16: 26476 (TID-7622(p.57-73))
BROWNING, W. E., Jr., Release of fission products on in-pile melting of reactor fuels, 16: 26488 (TID-7622(p.207-15))
BRUCK, H., Possibility of 15-Bev proton accelerator, 16: 25919 (NP-11977(p.20-31))
BRUECHER, Erno, Adsorption of U(IV) to humic substances, 16: 25364
BRUNZIE, G. F., Dissolution of U in U–U oxides, 16: 25483 (UAC-4745)
BRYANT, L. T., Stability analysis of EBR-II, 16: 26560
BRYDE ,Lise, Recoil ions from α reactions, 16: 26243
BRYUKHANOV, A. S., Mass spectrometer, 16: 25576 (FTD-TT-62-369)
BUCHANAN, J. R., Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
BUCHSBAUM, S. J., Cyclotron harmonics of a warm plasma, 16: 26418
BUCK, B., Nuclear collective motions, 16: 26334
BUCK, Otto, Apparatus for measuring electrical resistance, 16: 25769 (SCL-T-434)
BUEGGS, A. A., Solvent extraction of Be, 16: 25475 (NCL/AE-172)
BULBULIAN, Silvio, Studies on radioactive precipitation, 16: 25674
BULGIN, Douglas, Oil-extended polymers, 16: 25872
BULL, R. M., Cosmic μ-meson spectra, 16: 26055
BUNCAK, Pavol, Polarographic estimation of Nb, 16: 25290
BUNKIN, F. V., Spontaneous decay of quantum systems, 16: 25964 (JPRS-13656(p.233-59))
BURAS, Bronislaw, Radiation damage for study of properties of Ge, 16: 25849 (PAN-314/I-B)
BURCH, P. R. J., Biological principle and its converse, 16: 25106
BURNETTE, R. D., Removal of radioactive Kr and Xe from flowing He stream, 16: 26489 (TID-7622(p.218-35))
BURTON, Paul R., Stripping film in autoradiography, 16: 25508 (TID-16480)
BURTSCHER, A., Research reactor Astra, 16: 26623
BUSLAEV, Yu. A., Zirconium and Hf oxyfluorides, 16: 25326 (AEC-tr-5317)
BUSTAD, L. K., Biological effects of I-131 in sheep and swine, 16: 25118 (HW-72500(p.30-5))
BUSTAD, L. K., Effects of intradermal injections of Pu, 16: 25122 (HW-72500(p.50-1))
BUTLER, D., Fission properties utilized in reactor design, 16: 26512
BYRNEV, P. Kh., Edge problem in dispersion ratios, 16: 26077 (JINR-P-949)

C

CABANE, Gerard, Fragility of Fe–Al solid solution, 16: 25776
CABLE, J. W., Biological effects of I-131 in sheep and swine, 16: 25118 (HW-72500(p.30-5))
CABLE, J. W., Effects of intradermal injections of Pu, 16: 25122 (HW-72500(p.50-1))
CACCIANI, A., Photoproduction of neutral mesons, 16: 25898 (LNF-62/37 (p.98-104))
CAFASSO, Fred A., Magnetic susceptibility of ReF_6, 16: 25347
CAFORIO, A., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
CAGLIOTI, G., Bragg multiple scattering of neutrons, 16: 26211
CAHILL, J. A., Density of liquid Fe, 16: 25825
CAILLAT, R., Ceramic fuels in France, 16: 25703 (AEC-tr-5216)
CAIRNS, Walter John, Fluid flow control systems, 16: 25538
CALAIS, Daniel, Growth of large perfect crystals of α U, 16: 25329 (AEC-tr-5249)
CALDER, R. S., X-ray and neutron diffraction analysis of LiH, 16: 25800
CALLESEN, O., Determining sand movement by labeled sand, 16: 25641
CALVILLO, Jose, Studies on radioactive precipitation, 16: 25674
CAMAGNI, P., Conductivity in plastically deformed alkali halides, 16: 25316 (NP-11921)
CAMAGNI, P., Luminescence of alkali halides, 16: 25914 (NP-11920)
CAMBEY, L. A., Mass differences between Sn isotopes, 16: 26335
CAMPAN, J. L., Neutron flux in equilibrium in natural U, 16: 26529
CAMPAN, J. L., Physical research on RAPSODIE, 16: 26569
CAMPBELL, E. C., Nuclear isomers, 16: 26254
CAMPISE, A. V., Advanced Epithermal Thorium Reactor (AETR) physics, 16: 26568
CANDIOTTI, C., Experience with reactors EL 2 and EL 3, 16: 26626
CAPPELLINI, M., Intestinal absorption of I^{131}-labeled triolein, 16: 25218
CAPPS, R. H., S-wave $\bar{K}$-N scattering amplitudes, 16: 26137
CARDEN, William H., Mechanical face seal, sealing theory, 16: 25507 (TID-15988)
CARLETON, N. P., Electron energy distribution in slightly ionized air, 16: 25989
CARNEVALE, Edmund H., Ultrasonic temperature determinations in plasma, 16: 26404 (RAD-TR-61-13)
CARO, Rafael, Design of exponential experiment, 16: 26469 (JEN-89-DF/I-28)
CARON, Henri L., Separating Cs, 16: 25485
CARPENTER, S. G., Epithermal critical experiments, 16: 26525
CARROLL, A., Measurement of the triple scattering parameter, 16: 26140
CARROLL, F. Ivy, Prog. rpt. on anti-radiation compounds, 16: 25249 (NP-11740)
CASALI, F., Neutron flux distribution gage, 16: 25562 (NP-11705)
CASE, A. C., Effect of age on retention of Sr and Ca, 16: 25113 (HW-72500(p.13-14))
CASE, A. C., Inhalation of dust containing Np-237, 16: 25124 (HW-72500 (p.56-60))
CASE, A. C., Radioisotopes in studying waterfowl dispersion, 16: 25142 (HW-72500(p.139-43))
CASEY, H. W., Effect of age on retention of Sr and Ca, 16: 25113 (HW-72500(p.13-14))
CASEY, H. W., Transfer of heavy radionuclides to milk, 16: 25121 (HW-72500(p.44-9))
CASON, C. M., Design of ARGMA 8,000-kw plasma facility, 16: 25499 (ARGMA-TN-2H5N)
CASSAGNOU, Y., Reaction $Li^7(p,\alpha)\alpha$, 16: 26262

CASTILLEJO, L., Pion-nucleon coupling constant, 16: 26105
CATER, E. David, Vaporization and thermodynamic properties of US and UOS, 16: 25399
CATTONI, A., Polarization of external bremsstrahlung, 16: 26106
CAVIN, D., Fuel cycles and loading for water-cooled research reactors, 16: 26620 (ORNL-TM-277)
CELLINI, R. Fernandez, Organic moderators and coolants, 16: 25312 (JEN-90-DQ/I-24)
CERCHIA, R., Elements of plan of 10-Bev electron synchrotron, 16: 25929 (NP-11977(p.78-80))
CERNIGOI, C., Prog. rpt. of Trieste group, 16: 25924 (NP-11977(p.55-7))
CERVIGNI, T., Effects of x rays on *Nicotiana tabacum*, 16: 25193 (CNEN-110)
CHA, Nam H., Spectroscopy of $0^{-}0$ transitions, 16: 26311
CHAMBERS, R. H., Dislocation relaxation spectra of cold-worked b.c.c. transition metals, 16: 25807 (GA-1745)
CHAN, C. H., Decay of ρ, ω, and K* particles, 16: 26157
CHANDER, Jagdish, Ionization of atomic and molecular beams, 16: 26020
CHANDRASEKHAR, S., Viscous flow between rotating cylinders. II., 16: 25537
CHAPMAN, R. N., Polymerization of ethylene by γ rays, 16: 25409 (BNL-740)
CHARLESBY, A., Crosslinking of polyethylene and paraffins by uv, 16: 25455
CHARPAK, G., Magnetic moment of the muon, 16: 26115
CHASANOV, M. G., Crystal structures of TiCd and Ti_2Cd, 16: 25828
CHAUMONT, J. M., Physical research on RAPSODIE, 16: 26569
CHAUMONT, J. M., Stability of fast reactors, 16: 26559
CHEBOTAREV, N. G., Newton's polygon and role in present mathematics, 16: 25692 (AEC-tr-5139)
CHEKNOVSKOI, V. Ya., Enthalpy of W, 16: 25779
CHELLIS, Robert D., Concrete usage in reactor support, 16: 25781
CHENG, C. H., Specific heat of b.c.c. Ti–V alloys, 16: 25806
CHERKAMOV, A. G., Mass spectrometer, 16: 25576 (FTD-TT-62-369)
CHERQUARD, J., Dissolved gases in water of swimming pool reactor, 16: 26495 (TID-7622(p.310-15))
CHERNICK, J., Correlation of integral experiments and high-energy cross-sections, 16: 26532 (BNL-5604; BNL-5892)
CHERNYSHEVA, T. I., Radiation polymerization and copolymerization of allylhydrosilanes, 16: 25459
CHERNYSHEVSKAYA, I. A., Changes in cortex in mature rabbits exposed to x radiation, 16: 25247
CHESNOKOV, V. N., Motion of electrons in magnetic system, 16: 26391 (FTD-TT-61-242(p.167-82))
CHEVALLIER, P., Transitions in O-16, 16: 26301
CHEVALLIER, P., Transition in B-11, 16: 26302
CHEYNIER, F., Measuring cross sections in fast reactors, 16: 26506
CHIAROTTI, G., Conductivity in plastically deformed alkali halides, 16: 25316 (NP-11921)
CHIAROTTI, G., Luminescence of alkali halides, 16: 25914 (NP-11920)
CHICK, Douglas Richard, Apparatus for detecting radioactivity in fluid, 16: 25596
CHICK, Douglas Richard, Apparatus for detecting radioactivity in fluid, 16: 25598
CHICK, Helen J., Newton's polygon and role in present mathematics, 16: 25692 (AEC-tr-5139)
CHIEH P'ENG (ZE PHENG), Kim, Equations of Chu-Low type for $\pi + N \to 2\pi + N$ process, 16: 26072 (JINR-P-891)
CHILDS, Charles B., Delineation of tracks of cosmic rays, 16: 25546 (AFOSR-3030)
CHIMAGLIA, Benito, Analyses of Al by neutron radioactivation, 16: 25288
CHIOTAN, C., Preparation of I-131, 16: 25488
CHIQUET-LOUEDEC, C., π^{+}-p elastic scattering, 16: 26120
CHRISTIE, James H., Estimation of liver size, 16: 25100
CHRISTIE, James H., Liver scanning, 16: 25190
CHUDAKOV, A. E., Lateral distribution of Cherenkov radiation from broad atmospheric showers, 16: 26062
CHUROWSKI, S., Radiation-induced oxidation of hydrocarbons, 16: 25424 (AERE-Trans-894)
CHUCHETTI, G., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
CHUGI, U., Instrumentation for space research, 16: 25588
CITI, S., Intestinal absorption of I^{131}-labeled triolein, 16: 25230
CLAIR, C., Neutron properties of RACHEL, 16: 26528
CLAIR, C., RACHEL critical assembly, 16: 26527
CLARK, Hugh K., Bucklings of Pu–H_2O, 16: 26463 (DP-701)
CLARK, John A., Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
CLARK, R. G., Removal of Pu from U, 16: 25474 (IS-470)
CLARKE, F. J. P., Irradiation damage in Be and Mg oxides, 16: 25865
CLASEN, Hermann, Power reactor operated with UF_4, 16: 26602 (AEC-tr-5164)
CLAUZON, P. P., Neutron flux in equilibrium in natural U, 16: 26529
CLAUZON, P. P., Physical research on RAPSODIE, 16: 26569
CLAUZON, P. P., Stability of fast reactors, 16: 26559
CLAYTON, Hilary, Heats of formation of U silicides and nitrides, 16: 25832
CLEGG, A. B., Missing $J = \frac{5}{2}$ state of Li-7, 16: 26247
CLIFFORD, A. F., Oxidation and stoichiometry of Pr and Ce oxides, 16: 25315 (NP-11758)
CLINE, J. F., Effect of nutrient K and Cs on uptake of Cs-137, 16: 25141 (HW-72500(p.134-8))
CLINTON, S. D., Radiation-induced sintering of ThO_2, 16: 25848 (ORNL-3275)
COBB, Harold M., Corrosion resistance of Zy-2, 16: 25726
COCHRAN, W., X-ray and neutron diffraction analysis of LiH, 16: 25800
COCKER, J. D., Preliminary work on Mo species in nitric acid, 16: 25311 (IG-Memo-466)
COCOLI, J. D., Cyclotron harmonics of a warm plasma, 16: 26418
CODD, J., Cermet and ceramic fast systems, 16: 26552
COEN, Edward D., Chemical protection of irradiated mice, 16: 25252 (TID-16160)
COGNE, F., Physics experiments in graphite lattices, 16: 26063 (CEA-2157)
COHEN, I., Study of UO_2–ZrO_2 system, 16: 25765 (WAPD-253)
COLBY, J. W., Growth of large perfect crystals of α U, 16: 25329 (AEC-tr-5249)
COLEGRAVE, E. H. M., Mixing particles using ribbon blender, 16: 25514 (NP-tr-889)
COLEGROVE, F. D., Nuclear polarization of He-3 gas, 16: 26332
COLEMAN, E. Jane, Uptake and distribution of thymidine by yeast, 16: 25136 (HW-72500(p.109-12))
COLEMAN, Paul D., High Energy Bunched electron beams, 16: 26368 (AFOSR-2580)
COLLIER, J. G., Pressure drop for flow of steam/water mixtures, 16: 25519 (AERE-R-3808)
COLLINS, E. S., Recoil loss from ceramic fuel elements, 16: 26487 (TID-7622(p.193-206))
COLLINS, G. D., Plutonium fuel processing and fabrication, 16: 25697 (GEAP-3876)
COLLINS, J. H., Control and safety in operation of NRX and NRU reactors, 16: 26614 (AECL-1486)
COLNER, W. H., Resistance strain gages, 16: 25559 (NAMC-ASL-1050 (Pt.II))
COLOMB, A. L., Fuel cycles and loading for water-cooled research reactors, 16: 26620 (ORNL-TM-277)
COLOMBO, P., Polymerization of ethylene by γ rays, 16: 25409 (BNL-740)
COLVER, C. Phillip, Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
COMBE, J. C., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
COMPERE, E. L., Radiation effects on thoria–urania slurries, 16: 26494 (TID-7622(p.282-99))
COMTE, R., RACHEL critical assembly, 16: 26527
CONDE, H., Absolute measurement of σ of Cf-252, 16: 26515
CONDO, George Thomas, Multinucleon capture of K⁻ mesons, 16: 26084 (NP-11623)
CONFORTO, G., Radiative capture of μ^{-} mesons in Fe, 16: 26142
CONN, P. K., Recoil loss from ceramic fuel elements, 16: 26487 (TID-7622 (p.193-206))
CONNERS, Philip, Non-static effects in OPEP, 16: 26166
CONNOLLY, P. L., Decay of negative hyperon, 16: 26141
CONNOLLY, T. F., Bibliography on reactor fuel reprocessing and waste disposal. IV., 16: 25476 (ORNL-2971(Vol.4))
CONSOLI, Terenzio, Reduction of scattering losses and containment, 16: 26408

CONVERSI, M., Polarization of neutrons, 16: 25922 (NP-11977(p.49-52))
CONVERSI, M., Radiative capture of μ mesons, 16: 25923 (NP-11977 (p.53-4))
CONVERSI, M., Radiative capture of μ^- mesons in Fe, 16: 26142
COOK, L. F., Photon an elementary particle?, 16: 26139
COOK, M. A., Transient electrode potentials of Ni, 16: 25322 (TID-16292)
COOPER, D. B., Corrosion resistances of metallic materials to LiH, 16: 25718 (NP-11952)
COOPER, W., Solution properties of polybutadiene, 16: 25363
COOPER, Wilfrid, Production of graft polymers, 16: 25871
CORDFUNKE, E. H. P., Volatile oxides of materials used in nuclear technology, 16: 25381
CORTELLESSA, C., Photoproduction of π^0 mesons from H_2, 16: 25936 (NP-11977(p.102-4))
CORTELLESSA, G., Photoproduction of neutral mesons, 16: 25898 (LNF-62/37(p.98-104))
CORTINI, G., Interaction of high-energy photons with heavy nuclei, 16: 25949 (NP-11977(p.144-6))
COULSON, C. A., Correlation energies for 1s2s ^3S and ^1S states of He-like ions, 16: 26004
COX, D. E., Neutron diffraction of Fe_2O_3–V_2O_3, 16: 25366
COX, J. F., Fission product levels in SM-1 coolant, 16: 26490 (TID-7622 (p.236-42))
COX, S., Fission properties utilized in reactor design, 16: 26512
COXOM, C. H., Radiochemical examination of errors in mine assaying, 16: 25635
COYNE, D. G., Bubble density measurement, 16: 25883 (CTSL-33)
CRAGGS, J. D., Attachment and ionization coefficients, 16: 26030
CRAIG, P. P., Paramagnetism of Fe impurities in transition metals, 16: 25999
CRAIK, R. L., Phase equilibria in U-rich binary alloys, 16: 25785
CRAWFORD, Frank S., Jr., Three-body decays of neutral K mesons, 16: 26151
CREEK, G. E., Fission products from reactor-grade UO_2, 16: 26484 (TID-7622(p.149-59))
CRESPO, Godofredo Gomez, Liver scanning, 16: 25190
CRIBIER, D., Optical frequencies of CeF_3, 16: 25978
CRIDDLE, W. J., Radiation chemistry of carbohydrates. IX., 16: 25439
CRIDDLE, W. J., Radiation chemistry of carbohydrates. X., 16: 25440
CROFT, J. F., Emergency air sampling, 16: 25542 (AEEW-R-150)
CROMPTON, R. W., Motions of electrons in gases, 16: 26034
CROUZET, C., Action of γ rays on polyoxyethyleneglycol, 16: 25447
CUMMINS, J. D., Computer procedure for synthesizing control systems, 16: 26454 (AEEW-R-156)
CUNNINGHAM, Joseph, Optical absorption in KNO_3 crystals, 16: 25451
CUNNINGHAM, Joseph, Radiolysis of ionic nitrates, 16: 25453
CURRIER, Edwin L., Jr., Fuel-breeder fuel element, 16: 26580
CURRIN, James D., Exchange relaxation of hfs in ESR, 16: 25986
CUSWORTH, Frederick Alan, Thermocouple cables, 16: 25599
CUTHILL, J. R., Phases in Nb–Sn alloys, 16: 25791
CVETANOVIC, R. J., Separation of isotopically substituted hydrocarbons, 16: 25427
CZACHOR, Andrzej, Properties of Ge bombarded with neutrons, 16: 25851 (PAN-316/I-B)
CZAPEK, G., High-energy elastic scattering, 16: 26122

D

DAANE, A. H., Allotropy of Sc, 16: 25824 (IS-310)
DABROWSKI, Janusz, Diffraction scattering of deuterons. II., 16: 26228 (PAN-300/VII)
DABROWSKI, Janusz, Optical model potential, 16: 26229 (PAN-304/VII)
DAIYASU, Kazuaki, Approach to multiple meson production, 16: 26170
DALGARNO, A., Diffusion and mobilities, 16: 26040
DALGARNO, A., Electronic recombination, 16: 26031
DALGARNO, A., Range and energy loss, 16: 26039
DALLAPORTA, N., Electromagnetic form factors of mesons and baryons, 16: 25896 (LNF-62/37(p.81-8))
D'AMATO, F., Mutations induced by radiation in wheat, 16: 25196 (CNEN-120)
DANBY, G., Existence of two kinds of neutrinos, 16: 26147
DANERI, A., Quantum theory of measurement, 16: 26439
DANGLE, R., Proton-oxygen differential scattering cross sections. II., 16: 26323
DANIELSON, G. C., Seebeck effect in Mg_2Si, 16: 25799 (IS-362)
DANILIN, A. S., Rate of vaporization of metallic oxides, 16: 25403
DARBY, Wilda, Properties of K_2NbO_3F, 16: 25359
DAROVSKIKH, V. F., Light fragmentation products and fission at high energies, 16: 26329
DARRIULAT, P., Elastic scattering of polarized protons by C-12, 16: 26301
DAS, Nirmal K., Chromosome breakage by x rays, 16: 25217
DAS GUPTA, N. N., Sedimentation studies on DNA from irradiated *E. coli*, 16: 25218
DATE, M., Excretion of P-32, 16: 25163
DATES, L. R., Argonne fast critical facility (ZPR-VI), 16: 26526
DAUNT, J. G., Spin interaction in solid He, 16: 25981
DAVID, H. A., Estimation of strength of radioactive source, 16: 25548 (AROD-2763:9)
DAVIDSON, P. M., Temporal growth of ionization in inert gases, 16: 26008
DAVIDSON, S. L., Thermal analysis of SM-1 Core III, 16: 26583 (APAE-105 (Suppl.1))
DAVIES, D. M., Prog. rpt. on power reactors, 16: 25735 (NMI-7251)
DAVIS, G., Reaction $O^{17}(t,p)O^{19}$ in a nuclear reactor, 16: 26291
DAVIS, H. T., Mobility of ions in liquid He^4I and He-3, 16: 25984
DAVIS, J. A., Extrapolation distances in die-away experiments, 16: 26308
DAVIS, J. J., Radionuclides in Arctic plants and animals, 16: 25149 (HW-72500(p.165-9))
DAY, P., Decay scheme of Es-254, 16: 26289
DAYTON, R. W., Reactor Materials, Vol. 5, No. 2, 16: 25709
DAZAI, Tsunekichi, Analysis of $F^{19}(d,p)F^{20}$ reaction, 16: 26339
DEARNALEY, G., Neutron-induced reactions in Si, 16: 26306
DE BEER, A., Decay of Co-58, 16: 26337
DE BEER, A., Decay of Mn-54, Zn-65, and Co-57, 16: 26336
DE BEER, A., Fluorescence yield of Cr, Mn, Cu, and Ga, 16: 26000
DE BRUIN, H. J., Solvent extraction of mono(silicylato)beryllium, 16: 25485
DEBRUNNER, P., Transmission and line broadening in Mössbauer effect, 16: 26225 (NP-11913)
DE CELLES, Paul C., Heavy pions and π-N vertex function, 16: 26144
DE FRANCISCO, Jose Luis, Design of exponential experiment, 16: 26469 (JEN-89-DF/I-28)
DEKHTYAR, I. Ya., Diffusion parameters in Ni, 16: 25831
DELATTRE, P., Work with French research reactors, 16: 26624
DELAVIGNETTE, P., Dislocations and fission damage in Pt, 16: 25963
DELVES, L. M., Approximation method for breakup reactions, 16: 26279
DELVES, L. M., Neutron-deuteron polarization, 16: 26102
DEMA, I., Preparation of I-131, 16: 25488
DE MASTRY, John A., Prog. rpt. on Nb-base alloys, 16: 25695 (BMI-X-188)
DEMIDOV, V. S., Elastic π^- meson scattering on C, 16: 26365
DEMINA, N. V., Unobserved region in photoproduction dispersion ration, 16: 26073 (JINR-P-904)
DENIELOU, M., Siloe—research reactor at Grenoble, 16: 26622
DENISOV, Yu. N., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
DENTON, W. H., Carbon transport in GCR, 16: 26473 (TID-7622(p.1-23))
DEO, Bibhuti B., Four-boson contact interaction, 16: 26107
DE PRETIS, M., Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37(p.105-9))
DEREM, A., π^0-p elastic scattering, 16: 26120
DERKSEN, W. L., Prog. rpt. on thermal radiation studies, 16: 25876 (AFSWP-844)
DE SALAMANCA, M. Enriquez, Description of JEN-1 Reactor, 16: 26617 (JEN-97-DF/I-30)
DE SANTIS, V., Electromagnetic form factors of mesons and baryons, 16: 25896 (LNF-62/37(p.81-8))
DESJARDINS, Michel, Molybdenum–Ti–Zr–O at 1500°C, 16: 25826
DE SOUZA, B. C., Isotopic exchange in cobaltous–cobaltic system, 16: 25353
DESSLER, A. J., Diurnal variation of cosmic radiation, 16: 26059
DE SWART, J. J., Hyperon-nucleon scattering, 16: 26091 (NYO-10234)
DE TOLLIS, B., Photoproduction of π^0 from polarized γ, 16: 25933 (NP-11977(p.94-6))
DETRICK, Lawrence E., Changes across irradiated rat intestinal villi, 16: 25180 (TID-16271)

DETRICK, Lawrence E., Mucopolysaccharides in post-irradiation intestinal absorption, 16: 25179 (TID-16270)
DEUTCH, M., Polarization of recoil protons, 16: 25939 (NP-11977(p.111-15))
DEUTCH, M., Scintillation chambers, 16: 25940 (NP-11977(p.116-20))
DEUTSCH, M., Cross section of the process $\gamma + p \rightarrow \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
DEVINS, D. W., Scattering of protons from Ni-60 and Pb-208, 16: 26282
DE VRIES, Thomas, Electrode potential of Ru(IV), 16: 25343
DEVEY, John M., Ground displacement from surface burst, 16: 25087 (NP-11817)
DE WIRE, J., Production of π^0 by polarized photons, 16: 25934 (NP-11977 (p.97-99))
DIAMBRINI, G., Bremsstrahlung intensity from electron synchrotron, 16: 26136
DIAMBRINI, G., Polarized photon beam from Frascati synchrotron, 16: 25932 (NP-11977(p.93-4))
DI CAPUA, E., Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
DI CAPUA, E., Use of He bubble chamber, 16: 25925 (NP-11977(p.60-2))
DICKERMAN, C. E., Safety programme in Trent, 16: 26564
DICKINSON, B., Excited states of B-10, 16: 26281
DICKSON, A. K., Nuclear heating of non-fissile material, 16: 26231 (TRG-Report-322)
DI CORATO, M., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
DIDDENS, A. N., Nucleon-nucleon total cross sections, 16: 26145
DIETRICH, K., Five-body problem, 16: 26452
DIETRICH, O. W., Fast-neutron spectra, 16: 26530
DI LELLA, L., Polarization of neutrons, 16: 25922 (NP-11977(p.49-52))
DI LELLA, L., Radiative capture of μ mesons, 16: 25923 (NP-11977(p.53-4))
DI LELLA, L., Radiative capture of μ^- mesons in Fe, 16: 26142
DILLENBURG, Darcy, Effect of perturbations on angular correlations, 16: 26250
DILWORTH, C., Ionization measurements from H_2 bubble chamber, 16: 25921 (NP-11977(p.45-48))
DIRIAN, G., Dissolved gases in water of swimming pool reactor, 16: 26495 (TID-7622(p.310-15))
DIRIAN, J., Physical constants of isotopic substitutions in water, 16: 25307 (CEA-Bib-15)
DISKIND, Theodore, Heat transfer in eccentric annuli, 16: 25526 (NYO-9649)
DITCHBURN, R. W., Photoionization processes, 16: 26027
DIVEN, B. C., Measurements of α for monoenergetic neutrons, 16: 26510
DIVEN, B. C., Numbers of prompt neutrons per fission, 16: 26514
DIX, Donald M., Magnetohydrodynamic flow, 16: 25913 (NP-11892)
DMITRIEVSKII, V. P., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
DOBISH, O., Reactivity of hydrocarbon during interaction with free methyl radicals, 16: 25335
DOBLER, F. X., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
DOCKUM, N. L., Autoradiographic localization of Zn-65, 16: 25133 (NW-72500(p.97-101))
DOGGETT, Wesley O., Time correlation method for two connected nuclear transformations, 16: 26215 (AROD-2543.5)
DOKE, Tadayoshi, Gamma dose rates in Japan, 16: 25675
DOLINSKII, E. I., Analytic properties of nonrelativistic diagrams, 16: 26186
DOLLE, L., Dissolved gases in water of swimming pool reactor, 16: 26495 (TID-7622(p.310-15))
DOMENICI, M., Facilities of Avogadro RSI reactor, 16: 26625
DOMOKOS, G., Regge-poles and elastic scattering, 16: 26070 (JINR-E-991)
DONNELLY, R. J., Mobility of ions in liquid He^4I and He-3, 16: 25984
DORE, U., Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
DORE, U., Use of He bubble chamber, 16: 25925 (NP-11977(p.60-2))
DORSI, D., Rare earth Laves phases, 16: 25798
DOUGHMAN, C. L., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
DOUGLAS, D. G., Gamma spectrum of Tb-160, 16: 26264
DOUGLASS, D. L., Hardness anisotropy of Nb, 16: 25818
DOUGLASS, R. M., Preparation of UC–PuC solid solutions, 16: 25706
DRANGEID, K. E., Magnetic field penetrating a superconductor, 16: 25997
DRAYCOTT, A., Purification of CO_2 for reactor. III., 16: 25299 (AAEC/E-86)
DREYER, H. S., Fission gases from defective sheathed ceramic fuel elements, 16: 26485 (TID-7622(p.160-70))
DROGUETT, Sergio, Heavy water in Chile, 16: 25621
DROZDOVSKII, V. F., Gamma-induced degradation of butyl rubber, 16: 25869
DU BAILLER, A. Teste, Physical measurements in Marcoule reactors, 16: 26460 (CEA-2158)
DU BOIS, D. F., Collision damping of plasma oscillations, 16: 26416
DUCKWORTH, H. E., Mass differences between Sn isotopes, 16: 26335
DUELL, P. M., Structures in binary salt solutions, 16: 25358
DUGAS, D. J., Solar flares and space flight, 16: 26631 (RM-2825-PR)
DULAU, J., Measurement of integrated doses by mechanography, 16: 25550 (CEA-2128)
DULLEMOND, C., Hyperon-nucleon scattering, 16: 26091 (NYO-10234)
DUMKE, Warren L., Crystal structure of bis(m-bromobenzoyl) methane, 16: 25262 (IS-295)
DUNAITSEV, A. F., Charge exchange of π^- mesons stopped in H_2, 16: 26190
DUNCAN, J. F., Beta recoil from solid surfaces, 16: 26009
DUNN, A. L., Radioisotope accountability system, 16: 25663
DUNN, P. D., Direct conversion of fission heat to electric power, 16: 25972
DU PERRE, R. M., Truarc retaining ring failure, 16: 26612 (HW-73643)
DUPOUY, J. M., Atomic arrangements in Ti–Mo, 16: 25772 (NYO-7062)
DZHELEPOV, V. P., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)

E

EARWAKER, L. G., Half lives of C-10 and Ne-19, 16: 26244
EAVES, D. E., Solution properties of polybutadiene, 16: 25363
EBERLE, A. R., Determination of Zr in Th–Zr alloys, 16: 25284
ECKER, G., Probe theory in dense plasma, 16: 26405 (UCRL-10128)
EDESKUTY, F. J., Cryogenic engineering in nuclear rocketry, 16: 25516
EDGE, R. A., Scandium, Y, Nd, Ce, and La silicate rocks, 16: 25287
EDWARDS, D. O., Spin interaction in solid He, 16: 25981
EDWARDS, S. F., Ground state energy of liquid He, 16: 26007
EDWARDS, S. F., Proton bombardment of He-3 and H-3, 16: 26260
EFFERDING, L. E., Design of CVTR pressure tube, 16: 26585 (CVNA-95)
EFIMENKO, J., Thermodynamic study of Th phosphides, 16: 25383
EFIMOV, G. V., Non-renormalization theories, 16: 26079 (JINR-P-964)
EGAN, J. J., Standard molar free energy of formation of some chlorides of Mg, Ce, U, and Th, 16: 25392
EGAN, James J., Thermodynamics of solutions of actinides and fission products in Bi, 16: 25391
EGELAND, A., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
EGELSTAFF, P. A., Doppler broadening of slow neutron resonances, 16: 26214 (AERE-M-1035)
EGIDI, A., Polarization of neutrons, 16: 25922 (NP-11977(p.49-52))
EGOROV, L. B., Anomalies in μ^- meson decay in paramagnetic metals, 16: 26080 (JINR-P-972)
EHLER, A. W., Prog. rpt. on H_2^+ dissociation, 16: 26092 (TID-16031)
EHRLICH, J. J., Design of ARGMA 8,000-kw plasma facility, 16: 25499 (ARGMA-TN-2H5N)
EICHHOLZ, G. G., Toxicity hazards of U alloys, 16: 25664
EICHLER, E., Nuclear levels of Ge-74, 16: 26283
EICK, Harry A., Vaporization studies of UC_2 phase, 16: 25393
EINSTEIN, Fred S., Scans of brain tumors, 16: 25102
EISENBERG, Benson, Electron beam 10-35 Mev betatron doses, 16: 25189
ELBERT, Donne D., Viscous flow between rotating cylinders. II., 16: 25537
ELDER, Fred A., Photoionization of alkyl free radicals, 16: 25435
ELDRIDGE, H. B., Optical emission from irradiated metallic foils, 16: 25847 (ORNL-3114)
ELDRIDGE, H. B., Optical emission from irradiated foils. I., 16: 26314
ELLEMAN, T. S., Xenon-133 diffusion in alumina, 16: 26491 (TID-7622 (p.245-53))
ELLEMAN, Thomas S., Determination of short-lived fission-product gases, 16: 25295

ELLIOTT, R. O., Alloying additions on $\gamma \rightleftharpoons \alpha$ transformation. I., 16: 25797
ELLIS, Richard B., Surface tension of fused salts, 16: 26482 (TID-7622 (p.128-36))
ELLISON, R. J., Excited states of B-10, 16: 26281
ELLYSON, J. H., Development of the CVTR moderator tank, 16: 26586 (CVNA-108)
ELMENDORF, Ernest, Scintillation scanning of the liver. II., 16: 25099
ELSEA, A. R., Effects of Nb on steel, 16: 25811
ELWELL, W. T., Analysis of Nb and Nb alloys, 16: 25294
ELWELL, W. T., Atomic absorption spectrophotometry, 16: 25297
EMELEUS, K. G., Plasma electron oscillation, 16: 26411
EMURA, Satoru, Junior cave for chemical procedures, 16: 25260 (JAERI-1029)
ENCE, Elmars, Behavior of the Ti–8Al–8Zr–1(Ta + Cb) alloy, 16: 25813
ENDEBROCK, R. W., Reactor Materials, Vol. 5, No. 2, 16: 25709
ENGEL, J. R., Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
ENGELMANN, P., Fast breeder economy, 16: 26547
ENGLE, L. B., Energy and time dependence of delayed gammas, 16: 26222 (LAMS-2642)
ENOCH, Jacob, Electron distribution function of ionized gas, 16: 25951 (R62SD64)
ERBA, E., Statistical emission in nuclear reactions, 16: 26516
ERDMAN, H. E., Developmental arrest or irradiated Ephestia larvae, 16: 25134 (HW-72500(p.102-3))
ERDMAN, H. E., X-ray tolerance of two related species of beetles, 16: 25146 (HW-72500(p.156-8))
ERDMANN, Joachim C., Influence of crystal field on ion-core states, 16: 25884 (D1-82-0171)
ERIKSSON, B., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
ERMOLENKO, I. N., Study of UO_2^{++} sorption by cellulose materials, 16: 25336
EROE, J., Circular polarization of γ quanta, 16: 26267
ERWIN, A. R., Experimental cross section for $\pi^- \rightarrow K\bar{K}$, 16: 26146
ESTRADA, J., Systems of H_2SO_4 solutions of U and anionic resin, 16: 25330
ESTULIN, I. V., Circular polarization of γ quanta, 16: 26292
EVANS, Charles A., Immunization of the A/Jax mouse, 16: 25108
EVANS, J. F., Beta field dose rate determination, 16: 25650 (HW-52448)
EVERETT, Allen E., Evidence that spin of Z is even, 16: 26152
EVERLING, F., Beta-decay energy systematics, 16: 26287 (IS-408)
EVTEEV, V. L., Unobserved region in photoproduction dispersion ratios, 16: 26073 (JINR-P-904)
EYRING, Leroy, Prog. rpt. on rare earth oxides, 16: 25323 (TID-16350)

F

FACCHINI, U., Emission in (p,α) and (d,α) reactions, 16: 26309
FACCHINI, U., (n,α) Reactions in heavy elements, 16: 26297
FACCHINI, U., Statistical emission in nuclear reactions, 16: 26516
FAHRIG, R. H., Purification of CdS crystals, 16: 25878 (ARL-62-319)
FALCONER, W. E., Separation of isotopically substituted hydrocarbons, 16: 25427
FALLONE, E. M., Lunar and planetary exploration colloquium, 16: 25094
FARAGGI, H., Elastic scattering of polarized protons by C-12, 16: 26263
FARINELLI, U., Neutron flux distribution gage, 16: 25562 (NP-11705)
FARIS, John P., Separation of rare earths, Y, and Sc, 16: 25280 (TID-15598)
FARLEY, F. J. M., Magnetic moment of the muon, 16: 26115
FARNOUX, B., Optical frequencies of CeF_3, 16: 25978
FASANA, A., Polarization of external bremsstrahlung, 16: 26106
FAZACKERLEY, H., Radiation effects in peppermint oil, 16: 25450
FEAR, R. C., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
FEDER, H. M., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
FEDER, H. M., Thermodynamics of systems of U with Zn, Cd, Ga, In, Tl, Sn, and Pb, 16: 25397
FEDOROV, G. B., Properties of Zr and its alloys with Sn, 16: 25406
FEDRIGHINI, A., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
FEINBERG, G., Decays of G eigenstates, 16: 26148
FEISTMAN, Myron L., Digital transducers, 16: 25565 (NP-11860)
FELBER, Frank F., Jr., Helium generation and release in irradiated BeO, 16: 26492 (TID-7622(p.254-62))
FELBERBAUM, Jean, Analysis of parameters of U-233, U-235, and Pu-239 16: 26216 (BNL-722)
FELDMAN, A. S., Radiation polymerization and copolymerization of allyltrosilanes, 16: 25459
FELDMAN, David, Prog. rpt. on high-energy physics, 16: 25952 (TID-16011)
FELDMAN, M. S., Production of D and other light isotopes, 16: 25688 (AEC-tr-5199)
FELDMAN, Myre S., Photographic film-plate for measuring radiation, 16: 25574 (AEC-tr-5193)
FELMLEE, Thomas, Prog. rpt. on rare earth oxides, 16: 25323 (TID-16350)
FELTEN, E. J., Formation of $UO_{3.00} \cdot 6YO_{1.5}$, 16: 25350
FENIN, Yu. I., On T + T → He^4 + 2n reaction, 16: 26075 (JINR-P-911)
FENYES, Tibor, Semiconductor nuclear spectrometers, 16: 25585
FENYVES, E., Inelastic (n,p) cross section, 16: 26252
FERGUSON, A. T. G., Fast-neutron data and fast-neutron cross-section measuring, 16: 16: 26504
FERGUSON, A. T. G., Neutron-induced reactions in Si, 16: 26306
FERGUSON, A. T. G., Neutron-deuteron elastic scattering, 16: 26101
FERGUSON, E. E., Helium emission λ10830Å in aurorae, 16: 26002
FERGUSON, J. M., Gamma spectra of Te-133m and Te-134, 16: 26239
FERNANDEZ, LeVerne P., Diffusion coefficient of α emitter in solid, 16: 25309 (DP-727)
FERRARA, D., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
FERRERO, I., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
FERRIS, Leslie M., Hydrolysis of U carbides, 16: 25341 (ORNL-TM-38 and Rev.1)
FERRO-LUZZI, Massimiliano, Measurement of Σ^- asymmetry parameter, 16: 26149 (UCRL-10238)
FETTWEIS, P. F., Nuclear isomers, 16: 26254
FEYNMAN, R. P., Theory of fundamental processes, 16: 26453
FIELDHOUSE, P., Prompt neutrons from U-235 fission, 16: 26513
FIGHETTI, Cesar, Heavy water in Chile, 16: 25621
FIGIER, J., Detection of β-indolylacetic acid in plant cells, 16: 25103
FINK, Frederick W., Corrosion of Th and U, 16: 25713 (BMI-1563)
FINK, Frederick W., Helium solubility in D_2O, 16: 25303 (BMI-1587)
FINZI, R., Photoproduction of π^+, 16: 25891 (LNF-62/37(p.34-9))
FINZI, R., Photoproduction of pions in H_2 and D_2, 16: 25943 (NP-11977 (p.124-5))
FIORONI, F., TIMER—Programmer with ferrite cores, 16: 25564 (NP-11822)
FIRTH, Kenneth, Apparatus for detecting radioactivity in fluid, 16: 25396
FIRTH, Kenneth, Apparatus for detecting radioactivity in fluid, 16: 25397
FISCHER, Ernst Otto, Aeromatic complexes of metals. LVII., 16: 25369
FISCHER, Ernst Otto, Aromatic complexes of metals. LIX., 16: 25370
FISCHER, G., Accident analyses for fast assemblies, 16: 26565
FISHER, Gerald, Prog. rpt. on spent fuel shipping, 16: 25647 (EURAEC-164)
FISHER, P. C., Energy and time dependence of delayed gammas, 16: 26222 (LAMS-2642)
FISHER, Ray W., Electrical resistivity of Th–Mg eutectic, 16: 25754 (IS-437)
FISHMAN, F. J., Deviation of MAST operation, 16: 25912 (NP-11848)
FITE, Wade L., Ionization cross sections, 16: 26036
FIZZOTTI, C., Phase equilibria in U-rich binary alloys, 16: 25785
FLAMANT, Yves, Scattering of neutrons by C, 16: 26288
FLATOR, Howard E., Sodium flow controller, 16: 25569 (TID-15915)
FLEISHMAN, D. G., Cesium and Sr in human organs, 16: 25157
FLEMING, J. D., Effects of radiation on silica, 16: 25856
FLEROV, G. N., Transfer of neutrons in Al, Cu, and Ta bombardment, 16: 26221 (JINR-P-973)
FLETCHER, E. E., Effects of Nb on steel, 16: 25811
FLINN, P. A., Debye-Waller factor for Mössbauer impurity atoms, 16: 26316
FLOTOW, Howard E., Thermodynamic properties of ZrH_2, ZrD_2, YH_2, and

YD_3, 16: 25395
FLYNN, Archie P., Family shelter evaluation, 16: 25657 (WT-359)
FOA, L., Coulomb photoproduction of π^0 on nuclei, 16: 25893 (LNF-62/37 (p.57-71))
FOA, L., Forward photoproduction of π^0 in H, 16: 25892 (LNF-62/37(p.46-56))
FOA, L., Production of π^0 in H_2, 16: 25937 (NP-11977(p.107-8))
FOA, L., Production of π^0 in H_2, 16: 25938 (NP-11977(p.109-10))
FORBES, Fred F., Cross sections for $C^{13}(Li^6,\alpha)N^{14}$ and $C^{13}(Li^7,\alpha)N^{16}$, 16: 26321
FORD, John O., Volatility of Pu carbide, 16: 25385
FORINO, A., Parity conservation in the reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$, 16: 25944 (NP-11977(p.127-9))
FORINO, A., Parity conservation pion production, 16: 25889 (LNF-62/37 (p.13-23))
FORLAND, T., Equilibrium measurements in UO_{2+x}, 16: 25373
FORSTER, H. H., Scattering of protons from Ni-60 and Pb-208, 16: 26282
FORSYTH, P. D., Reaction $Li^7(p,\alpha)n$, 16: 26262
FOSSDAL, E. A., Doppler effect of Pu-239 in fast reactors, 16: 26562
FOX, K., Infrared absorption spectrum of CD_4, 16: 25345
FRANCIS, G., Dielectric constant of plasma, 16: 26410
FRANGOPOL, P. T., Preparation of I-131, 16: 25488
FRANK, A. L., Optical emission from irradiated metallic foils, 16: 25847 (ORNL-3114)
FRANK, A. L., Optical émission from irradiated foils. II., 16: 26315
FRANK, P. W., Fission product activity levels in primary coolant of PWR, 16: 26599 (WAPD-PWR-TE-79)
FRANK-KAMENETSKII, D. A., Creation of nucleon pairs by photons, 16: 26097
FRANKLIN, E., Quadrupole radiation, 16: 26234 (NP-tr-885)
FRANKLIN, R. N., Dielectric constant of plasma, 16: 26410
FRANTZ, J., Angular correlations in $S^{32}(p,p'\gamma)$, 16: 26327
FRANZ, I., Scattering of low energy protons on S-32, 16: 26352
FRANZEN, Fr., Prog. rpt. on biogenic amines in radiation injuries, 16: 25250 (NP-11753)
FRATI, W., Mu mesonic atom studies of Ti, Fe, Cu, Zn, Tl, Pb, Bi, 16: 25909 (NEVIS-105)
FRAUENFELDER, H., Transverse polarization of conversion electrons following β decay, 16: 26086 (NP-11737)
FRAUENFELDER, H., Transmission and line broadening in Mössbauer effect, 16: 26225 (NP-11913)
FRAUTSCHI, S. C., Consequences of hypothesis of Regge poles, 16: 26128
FREDRICKSON, D. R., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
FRENCH, Eugene, Plutonium in man, 16: 25171
FRETWELL, L. J., Jr., Bubble density measurement, 16: 25883 (CTSL-33)
FREUND, P. G. O., Phases of proton's EM form factors, 16: 26112
FRIED, Zoltan, Spectroscopy of $0^+ \rightleftharpoons 0^+$ transitions, 16: 26311
FRIEDELL, Hymer L., Effect of actinomycin D and x radiation, 16: 25232
FRITZ, James S., Separation of V, 16: 25484 (IS-415)
FRITZ, K., Status of research reactors, 16: 26621
FROMM, Leonard W., Jr., Boiling-water nuclear reactor, 16: 26581
FRY, Arthur, Reactions of benzyl with various nucleophiles, 16: 25344
FRYE, Graham, Remark on diffraction scattering, 16: 26447
FUBINI, S., Asymptotic properties of scattering, 16: 26116
FUEREDI, H., Determination of CO_2 in solid carbonates, 16: 25291
FUJINARA, M. P., Incidence and virulence of columnaris, 16: 25145 (HW-72500(p.151-5))
FUJIMURA, Kimio, Beta-decay of Λ and Σ^- hyperons, 16: 26167
FUJIWARA, Izuro, Correspondence principle. I., 16: 26087 (NP-11780)
FUKETA, T., Thermal neutron absorption and scattering cross sections, 16: 26194 (JAERI-6010)
FULLER, E. G., Photodisintegration of Bi, 16: 26261
FURGUAY, James J., Green Glow diffusion program, 16: 25612 (HW-71400 (Vol.I))
FURTADO, A. F. A. Sanches, Portuguese U minerals, 16: 25638
FURTH, Harold P., Plasma motion across magnetic field, 16: 26414 (UCRL-6294)
FUSCHINI, E., Parity conservation pion production, 16: 25889 (LNF-62/37 (p.13-23))
FUSCHINI, E., Parity conservation in the reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$, 16: 25944 (NP-11977(p.127-9))

G

GABOVICH, M. D., Ion beam through plasma, 16: 26427
GAILLARD, J-M., Existence of two kinds of neutrinos, 16: 26147
GAJL, Donato, Treatment of radiation sickness, 16: 25259
GALANTINE, R. M., High-pressure Na generator designs, 16: 25502 (NAA-SR-Memo-6849)
GALASSO, Francis, Properties of K_2NbO_2F, 16: 25359
GALKIN, N. P., Chemistry and production of U fluoride compounds, 16: 25470
GALKIN, N. P., Principal processes and equipment in U production, 16: 25471
GALKINA, L. P., Polarizable properties of electrons of μ^3 meson disintegration, 16: 26177
GALLAGHER, C. J., Jr., Search for β^- decay of Hf-180m, 16: 26255
GALONSKY, A. I., Polarization of β following P-32 decay, 16: 26259
GANDOLFI, A., Instrumentation for space research, 16: 25588
GANGULI, P. K., Sedimentation studies on DNA from irradiated *E. coli*, 16: 25218
GARCIA-MUNOZ, M., Electron capture and loss, 16: 26043
GARCZYNSKI, W., Perturbation expansion of scattering amplitude, 16: 26437
GARDNER, D. G., Activation cross sections for 14.7-Mev neutrons, 16: 26268
GARDNER, J. W., Direct conversion and fusion reactors, 16: 25089
GARIN, A., Elastic scattering of polarized protons by C-12, 16: 26263
GAROFANO, M., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
GARRATT, P. G., Radiation effects in peppermint oil, 16: 25450
GARRIDO, L. M., Adiabatic invariance in quantum mechanics, 16: 26448
GARSCADDEN, A., Plasma electron oscillation, 16: 26411
GARSTANG, R. H., Forbidden transitions, 16: 26025
GARWIN, R. L., Magnetic moment of the muon, 16: 26115
GASANOV, G. I., Action of radiomimetic agent on yeast cells, 16: 25200
GATOS, H. C., Superconducting Nb_3In, 16: 25803
GATTO, R., Some problems of high-energy physics, 16: 25928 (NP-11977 (p.71-7))
GATTO, R , Storage ring for electrons and positrons (Adone), 16: 25930 (NP-11977(p.80-8))
GAVRILOVA, R. K., Absorbing load for diaphragm-type waveguide, 16: 26388 (FTD-TT-242(p.151-61))
GAZLEY, Carl, Jr., Minsk conference on heat and mass transfer, 16: 25527 (RM-2852-PR)
GAZLEY, Joy B., Minsk conference on heat and mass transfer, 16: 25527 (RM-2852-PR)
GEICHMAN, J. R., Hexafluorides of Mo, W, and U. I., 16: 25339 (GAT-T-969)
GELADI, G., Paper chromatography of Te(IV) and Te(VI), 16: 25265 (BLG/B-4)
GELBARD, E. M., Extrapolation distances in die-away experiments, 16: 26208
GELL-MANN, M., Consequences of hypothesis of Regge poles, 16: 26128
GEMMELL, W., Results with metallic and ceramic fuels, 16: 26524
GEORGE, D. W., Magnetohydrodynamic power generation, 16: 26412
GEORGE, L. A., II., Retention, translocation, and excretion of inhaled Pu, 16: 25125 (HW-72500(p.61-6))
GERASIMOVSKII, V. I., Zirconium--Hf ratio in minerals and rocks, 16: 25631
GERBERICH, W. W., Equipment for low-cycle fatigue tests, 16: 25606 (TID-15356)
GERECKE, G. E., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
GERLING, E. K., Age of radioactive minerals, 16: 25626
GEROLA, F. M., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
GERRARD, Martha W., Zirconium and Hf oxyfluorides, 16: 25326 (AEC-tr-5117)
GERSHON-COHEN, J., Radioisotope scanning of liver and spleen, 16: 25101
GERSHTEIN, S. S., Transition of negative mesons from H, 16: 26219 (JINR-P-942)
GERSTEIN, B. C., Heat capacity anomaly in Tb, 16: 25993
GERTNER, Anton, Structure of H_2O and D_2O solutions, 16: 25327 (AEC-tr-

5126)
GETHARD, P. E., Fission product retention studies of graphite reactor fuels, 16: 26486 (TID-7622(p.171-92))
GETHARD, P. E., Release of K and Xe fission products from (U,Th)C_2–graphite fuel matrix, 16: 25752 (GA-3211)
GETTY, W. D., Generation of dense plasma, 16: 26417
GEYER, M. A., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
GHATE, P. B., Correlations for vacancy diffusion, 16: 25992
GHESQUIERE, G., Physical research on RAPSODIE, 16: 26569
GHESQUIERE, G., Stability of fast reactors, 16: 26559
GHIGO, G., Storage ring for electrons and positrons (Adone), 16: 25930 (NP-11977(p.80-8))
GIALANELLA, G. C., Polarization of recoil nuclei, 16: 25941 (NP-11977 (p.120-1))
GIALANELLA, G. C., Use of He bubble chamber, 16: 25925 (NP-11977 (p.60-2))
GIAMATI, C. C., Experimental test of conservation of nucleons, 16: 26328
GIBSON, W. M., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
GIDLEY, J. A. F., Atomic absorption spectrophotometry, 16: 25297
GIESE, Clayton, Photoionization of alkyl free radicals, 16: 25435
GIGAS, G. G., Scattering of protons from Ni-60 and Pb-208, 16: 26282
GIGLI, A., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
GIGLI, A., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
GILBERT, A., Effects of solutes on refractory metals, 16: 25751 (DMIC-Memo-155)
GILBOY, W. B., Neutron inelastic scattering by Na-23, 16: 26508
GILINSKY, V., Collision damping of plasma oscillations, 16: 26416
GILLES, P. W., Vaporization processes of refractory substances, 16: 25389
GILLESPIE, Arthur S., Jr., Thallium-204 determination of dissolved O_2 in water, 16: 25282
GILLET, Vincent, Description of the O-16 spectrum, 16: 26303
GILLHAM, E. J., Radiometric standards and measurements, 16: 25595
GINGERICH, K. A., Thermodynamic study of Th phosphides, 16: 25383
GIRD, E., Preparation of I-131, 16: 25488
GLASS, John Alexander Forbes, Support structure, 16: 26579
GLASUNOV, V. V., Cesium and Sr in human organs, 16: 25157
GLAZOV, A. A., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
GLAZUNOV, P. Ya., Radiation polymerization of vinyl monomer on fiber, 16: 25431
GLENDENNING, N. K., Giant E1 resonance for deformed nuclei, 16: 26253 (UCRL-9803)
GLENDENNING, Norman K., Nucleon-nucleon triplet-even potentials, 16: 26126 (UCRL-9904)
GLOVER, R. N., Proton bombardment of B-10, 16: 26248
GNEUSHEV, M. I., Hygienic evaluation of construction materials and deactivating agents, 16: 25660 (JPRS-13691(p.8-12))
GODTS, J., Development of the CVTR moderator tank, 16: 26586 (CVNA-108)
GOLDBERG, E., Tory II-A neutronic machine calculations, 16: 26632 (UCRL-6304)
GOL'DBERG, M. B., Changes in peripheral blood of rats exposed to radiation, 16: 25248
GOL'DBERG, M. B., Conditioned reflex of white rat exposed to radiation, 16: 25238
GOLDBERGER, M. L., Photon an elementary particle?, 16: 26139
GOLDMAN, A., Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
GOLDRING, G., First excited 0^+ state in O-16, 16: 26298
GOLDSMITH, S., Prog. rpt. on reactor development, 16: 26467 (HW-73100)
GOLDSTEIN, H. W., Thermodynamics of vaporization of rare earth oxides, 16: 25386
GOLES, G. G., Abundances of I, Te, and U in meteorites, 16: 25623
GOLUB', V. N., Mass spectrometer, 16: 25576 (FTD-TT-62-369)
GOMI, M., Radiation cancer, 16: 25201
GONSER, J. G., Removal of Pu from U, 16: 25474 (IS-470)
GOODE, W. B., Fluorine cell research facility, 16: 25314 (KY-399)
GOODMAN, B. B., Properties of superconducting V_3Ga, 16: 25804
GOODWIN, Leslie E., Sampling valve for reactor coolant, 16: 26462 (DP-658)
GOPINATHAN, K. P., Preparation of Tb-161, 16: 25445
GORBATENKO, M. F., Interaction of electron beam with plasma, 16: 26434
GORBUNOVA, Yu. E., Zirconium and Hf oxyfluorides, 16: 25326 (AEC-tr-5117)
GOREN, S., Determination of Te in presence of Bi, 16: 25267 (IA-724)
GORIN, E., Prog. rpt. on β radiation as hydrogenation catalyst, 16: 25414 (NYO-10184)
GORITCHEV, P. A., Light fragmentation products and fission at high energies, 16: 26329
GORODETZKY, S., Transitions in O-16, 16: 26301
GORODETZKY, S., Transition in B-11, 16: 26302
GORYACHEV, B. I., Splitting of giant resonance in nuclei, 16: 26357
GOSSMANN, S. R., Kinetic effects of screen rods, 16: 26468 (IDO-16777)
GOSWAMI, A., Collective quadrupole state of C-12, 16: 26278
GOUDSMIT, P. F. A., Excited states of Ag-107, 16: 26280
GOULD, P., (p,d) Reaction at medium energies, 16: 26258
GOULIANOS, K., Existence of two kinds of neutrinos, 16: 26147
GRACE, C. S., Crosslinking of polyethylene and paraffins by uv, 16: 25435
GRADE, Marie Regina, Separation of chemical elements, 16: 25278 (SCL-T-423)
GRAF, P., Treatment of liquid waste at Würenlingen, 16: 26635 (EUR-20)
GRAFT, W. H., Resistance strain gages, 16: 25559 (NAMC-ASL-1090(Pt.I))
GRAHAM, W. W., III, Removal of radioactive Kr and Xe from flowing He stream, 16: 26489 (TID-7622(p.218-35))
GRAHAM, W. W., III, TNT—program for analyzing transient performance of HTGR fission product trapping system, 16: 26593 (GAMD-3168)
GRALA, Edward M., Properties of intermetallic compounds, 16: 25748 (ASD-TDR-62-476)
GRANGE, A., Type B packages, 16: 25672
GRASHIN, A. F., Linear equations of dispersion method with two-particle approximation, 16: 26085 (NP-11632)
GRASHIN, A. F., Resonance in a $K^0\Lambda^0$ system at 1650 Mev, 16: 26189
GRASS, R. C., Ordnance materiel exposed to atomic bomb detonation, 16: 25088 (PA-TR-1690)
GRAVES, H. W., Jr., Control rod material, Ag–In–Cd, 16: 25796
GRAVESON, Robert T., Effect of noise on pulse height resolution, 16: 25554 (HASL-118)
GREEBLER, P., Doppler effect in fast oxide reactor, 16: 26561
GREEN, A. M., Velocity-dependent nuclear forces, 16: 26251
GREEN, Earl L., Prog. rpt. on population genetics of irradiated mice, 16: 25182 (TID-16323)
GREENBERG, E., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
GREENBERG, Elliott, Fluorine bomb calorimetry. IV., 16: 25360
GREENWOOD, G. W., Effects of neutron irradiation on gamma U, 16: 25862 (AERE-R-3468)
GREGG, R. A., Cobalt end of Co–Al–B system, 16: 25793
GREGORY, A. G., Deuterons elastically scattered from C, 16: 26338
GRIBOV, V. N., Amplitudes of meson-nucleon and nucleon-nucleon scattering, 16: 26191
GRIDNEV, V. N., Formation of ω phase in Ti alloys, 16: 25830
GRIEM, Hans R., High-temperature shock waves, 16: 26029
GRIEVESON, P., Study of U borides and carbides by Knudsen effusion technique, 16: 25375
GRIFFIN, C. W., Power and stability tests on SRE, 16: 26223 (NAA-SR-7250)
GRIFFIN, E. E., Polarization of 7-8 Mev protons scattered from Ni-58 and Ti-48, 16: 26226 (NYO-10131)
GRIFFIN, E. E., Protons scattered from Ni-58 and Ti-48, 16: 26290
GRIFFITHS, D., X-ray and neutron diffraction analysis of LiH, 16: 25808
GRIGORESCU-SABAU, C., Ion exchange equilibria in presence of organic solvents. I., 16: 25354
GRILLI, M., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
GRILLI, M., Measuring the reaction $e^+ + e^- = K^+ + K^-$, 16: 25906 (LNF-62/37(p.166-79))
GRILLI, M., Photoproduction of π^+ with polarized photons, 16: 25935 (NP-11977(p.99-100))
GRILLI, M., Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
GRILLI, M., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37

(p.76-80))
GRILLY, E. R., Vapor pressure of Ne, 16: 25968
GRIMELAND, B., Slowing down of (D,D) neutrons in paraffin wax, 16: 26210
GRINGAUZ, K. I., Free-electron density in the ionosphere, 16: 26001
GRONVOLD, F., Chemical thermodynamics of actinide element chalcogenides, 16: 25388
GROSHEV, I. N., Current oscillations in thermionic energy converter, 16: 25957 (FTD-TT-62-637)
GROSS, Phillip, Heats of formation of U silicides and nitrides, 16: 25832
GROSSE, A. V., Relationship between surface tensions and energies of liquid metals, 16: 25351
GROSSE-RUYKEN, H., Purity testing of rare earths, 16: 25292
GROW, G. R., Brazing BeO to graphite, 16: 25739
GRUEN, Dieter M., Magnetic susceptibility of ReF_6, 16: 25347
GRUETTER, F., CERN 28-Gev proton synchrotron, 16: 26392
GRYZINSKI, Michal, Magnetic fields for plasma research, 16: 26403 (PAN-301/XVIII)
GSCHNEIDNER, K. A., Jr., Alloying additions on $\gamma \rightleftarrows \alpha$ transformation. I., 16: 25797
GUARD, R. W., Dispersion hardening, 16: 25693 (ARL-62-357)
GUIDONI, P., Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
GUIDONI, P., Use of He bubble chamber, 16: 25925 (NP-11977(p.60-2))
GUIZERIX, J., Memory of radioisotope thickness gages, 16: 25578
GUL'KO, A. D., Obtaining intense beam of polarized thermal neutrons, 16: 26198 (NP-11859)
GUPPY, C. B., Derivation of system transfer function, 16: 25543 (AEEW-R-154)
GUPTA, Ashis Sen, Mass and heat transfer through fixed and fluidized beds, 16: 25532
GUPTA, K. P., Specific heat of b.c.c. Ti–V alloys, 16: 25806
GUSEV, S. S., Study of UO_2^{++} sorption by cellulose materials, 16: 25336
GUSH, H. P., Crystal structure of solid H_2, 16: 25977
GUSTAFSSON, G., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
GUSTYAKOVA, M. P., Zirconium and Hf oxyfluorides, 16: 25326 (AEC-tr-5117)

H

HADORELL, V. J., Creep cavities in Mg alloys, 16: 25790
HAEFELE, W., Coupled fast-thermal reactor, 16: 26556
HAERTIG, M., Simple counter arrangements for weak activities, 16: 25584
HAES, D. L., Removal of Pu from U, 16: 25474 (IS-470)
HAFELE, J. C., Transistorized voltage control for magnet, 16: 25566 (NP-11883)
HAFFNER, J. W., Feasibility study of new mass flow system, 16: 25521 (ARF-1167-18)
HAGEBOE, E., Radiochemical studies of isotopes of Sb and Sn, 16: 25442
HAGEMAN, Louis A., Block iterative methods for two-cyclic matrix equations, 16: 25691 (WAPD-TM-327)
HAGERMARK, K., Equilibrium measurements in UO_{2+x}, 16: 25373
HAHN, G. T., Effects of solutes on refractory metals, 16: 25751 (DMIC-Memo-155)
HALL, J. D., Neutron-gamma spectrometer, 16: 25549 (ASD-TDR-62-52)
HALL, Richard B., Parallel plate plasma problem, 16: 25552 (D1-82-0173)
HALLER, J. T., Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
HALMANN, M., Thermal neutron capture of gaseous trimethylphosphine, 16: 25454
HALPERN, Aleksander, Hot atom chemistry of halogens. II., 16: 25417 (PAN-302/V)
HALSALL, M. J., Ground state energy of liquid He, 16: 26007
HAMADA, Tetsuji, Hydrogen counter for H-3, 16: 25592
HAMER, Allen Norman, Improvements relating to mass spectrometers, 16: 25600
HAMLEN, R. P., Ionic conductivity of Zr phosphate, 16: 25349
HAMMEL, E. F., Cryogenic engineering in nuclear rocketry, 16: 25516
HAMPEL, V. E., Tory II-A neutronic machine calculations, 16: 26632 (UCRL-6304)
HANEY, W. A., Disposal of radioactive liquid wastes, 16: 26637 (HW-64292)
HANEY, W. A., Hanford ground water flow, 16: 25613 (HW-73711)
HANFLING, R., Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
HANKEL, R., Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
HANSEN, G. E., Los Alamos fast-neutron critical assemblies, 16: 26533 (TID-13176)
HANSON, W. C., Radioisotopes in studying waterfowl dispersion, 16: 25142 (HW-72500(p.139-43))
HANSON, W. C., Radionuclides in Arctic plants and animals, 16: 25149 (HW-72500(p.165-9))
HAQUE, Dispersion relations applied to π^--p scattering, 16: 26123
HARA, Osamu, Sakata model and the K_{13} + decays, 16: 26160
HARATA, Y., Radiation effect on rainbow trout, 16: 25213
HARDER, B. R., Irradiation experiments with PuO_2 and $ThO_2 \cdot UO_2$, 16: 26493 (TID-7622(p.263-81))
HARDIE, G., Proton-oxygen differential scattering cross sections. II., 16: 26323
HARDIN, R. T., P122C control actuator, 16: 26457 (APEX-729)
HARDT, W., Pole surface face windings for DESY magnets, 16: 26370 (DESY-A1.9)
HARDY, J. R., ESR in tritium–polystyrene fluff system, 16: 25433
HARGITTAY, Gyula, Results of thermonuclear research. III., 16: 26409
HARPER, B. G., Radiation-induced crosslinking, 16: 25446
HARRER, Joseph M., Boiling-water nuclear reactor, 16: 26581
HARRIS, J. E., Creep cavities in Mg alloys, 16: 25790
HART, E. L., Decay of negative hyperon, 16: 26141
HART, Eugene M., Effects of outer-space environment, 16: 26627 (ASD-TR-61-201)
HARTY, H., Heavy water losses in PRTR, 16: 26616 (HW-73755)
HASEGAWA, H., Particles generated by a supernova, 16: 26048
HASEGAWA, Kenji, Meson-theoretical interactions in heavy nuclei, 16: 26340
HASKO, Stephen, Suaceptor elements for high-temperature induction heating, 16: 25704
HASTED, John B., Charge transfer and collisional detachment, 16: 26042
HASZKO, S. E., Rare earth Laves phases, 16: 25798
HAUBENREICH, P. N., Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
HAY, H. J., Reaction $Mg^{26}(p,\alpha)Na^{23}$, 16: 26310
HAYAKAWA, Satio, High-energy cosmic photons, 16: 26058
HAYES, A. F., Prog. rpt. on Be forging, 16: 25730 (ASD-TR-62-7-647)
HAYMAN, Colin, Heats of formation of U silicides and nitrides, 16: 25832
HAYWARD, Evans, Photodisintegration of Bi, 16: 26261
HEATH, R. L., Data analysis for scintillation spectrometry, 16: 25556 (IDO-16784)
HECHT, E., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
HECHT, K. T., Infrared absorption spectrum of CD_4, 16: 25345
HECKMAN, Harry H., Leptonic Σ^+ decay, 16: 26143
HEFFLEY, R. A., WHY—one-dimensional few-group diffusion code for IBM 1620, 16: 26195 (KAPL-M-CT-1)
HEGGBLOM, H., Reactivity in bare reactor, 16: 26540
HEIDEKLANG, H., Joining of refractory metals—W, 16: 25737 (WAL-TR-460.54/1-2)
HEIKKILAE, K. E., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
HEIL, Oskar, Heating of materials by electron beams, 16: 26065 (AFCRL-975)
HELLER, M. W., Seebeck effect in Mg_2Si, 16: 25799 (IS-362)
HELLSTRAND, E., Effective resonance absorption integrals for Zr and Nb, 16: 26511
HELLWEGE, K. H., Energy levels of nuclei: A = 5 to A = 257, 16: 26366
HENDERSON, W. K., Fluorine cell research facility, 16: 25314 (KY-399)
HENNACY, R. A., Removing inhaled radioactive particles, 16: 25127 (HW-72500(p.74-6))
HEREWARD, H. G., Accelerator research at CERN, 16: 25917 (NP-11977 (p.2-5))
HERNDON, R. C., Beryllium-9 in cluster model, 16: 26272
HERRICK, Claude C., Non-corrosive reactor fuel system, 16: 26577
HERRING, J. P., Retention, translocation, and excretion of inhaled Pu, 16: 25125 (HW-72500(p.61-6))

HERRIOTT, Roger M., Prog. rpt. on biochemistry, 16: 25152 (TID-16075)
HEUGHEBAERT, J., π^+-p elastic scattering, 16: 26120
HEWITT, G. F., Liquid film and pressure drop studies in annular two-phase flow, 16: 25520 (AERE-R-3921)
HEYNE, L., Electrical resistance of insulators during irradiation, 16: 25582
HIGASHIMURA, Tokunobu, Gamma dose rates in Japan, 16: 25675
HILDEBRANDT, Robert A., Separating actinide and lanthanide metal values, 16: 25495
HILL, John W., Reactions of benzyl with various nucleophiles, 16: 25344
HILL, R. J., Direct conversion of fission heat to electric power, 16: 25972
HILLIARD, R. K., Fission product release from U, 16: 25841 (HW-72321)
HILLS, P. R., Radiation effects in peppermint oil, 16: 25450
HILLSINGER, William R., Scans of brain tumors, 16: 25102
HINDS, S., Analysis of stripping optical model parameters, 16: 26300
HINES, Arthella P., Isotope shift in spectrum of Os, 16: 26317
HINTO, T., Studies of x-ray hematopoietic injury, 16: 25205
HIRE, L. L., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
HIRSHFELD, A. T., Gamma distribution from Ce-141, 16: 26242
HITESHUE, Raymond W., Hydrogenation of irradiated coal, 16: 25408
HOBBIE, Russell K., Cross sections for $C^{13}(Li^6,\alpha)N^{15}$ and $C^{13}(Li^7,\alpha)N^{16}$, 16: 26321
HOCH, Michael, Molybdenum–Ti–Zr–O at 1500°C, 16: 25826
HODGE, H. C., Changes in pigeon following inhalation of Hg vapor, 16: 25154 (UR-578)
HOEFGEN, H., Electrical resistance of insulators during irradiation, 16: 25582
HOEGASEN, H., Kemmer-algebra and Foldy-Wouthuysen transformations for particles with spin 0 and 1, 16: 26088 (NP-11781)
HOENIGSBERG, H. F., X-ray induction of dominant lethals, 16: 25192 (CNEN-121)
HOFFMAN, Joseph G., Volatility of Pu carbide, 16: 25385
HOKKYO, Noboru, Capture γ rays from infinite slab, 16: 26202 (AEC-tr-5077)
HOLCOMB, D. F., Paramagnetic relaxation of color centers in KCl, 16: 25985
HOLLAND, H. D., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
HOLLAND, J. W., Efficiency of thermionic converters, 16: 25908 (NAA-SR-Memo-7278)
HOLLAND, W. C., Entry of Ca-45 in rabbit ventricles, 16: 25107
HOLLAND, W. D., Determination of Fe and U, 16: 25281
HOLLIS, E. T., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
HOLLISTER, William L., Bibliography on radiation effects on cables and insulation, 16: 25846 (NP-11929)
HOLLOWAY, W. W., Jr., Hyperfine structure of atomic N, 16: 26318
HOLMBERG, Bo., Prog. rpt. on rare earth oxides, 16: 25323 (TID-16350)
HOLMES, J. M., Control of pot calciner temperatures, 16: 26640 (ORNL-TM-259)
HOLTZ, F. C., Prog. rpt. on Zr alloys, 16: 25746 (ARF-2230-9)
HONE, D. W., Lattice measurements with 7-element UO_2 clusters, 16: 26461 (CRRP-1072)
HONECK, H. C., Correlation of integral experiments and high-energy cross-sections, 16: 26532 (BNL-5604; BNL-5892)
HONECK, Henry C., THERMOS code for reactor lattice calculations, 16: 26459 (BNL-5826)
HONGO, K., Nucleic acid in chick embryo after irradiation, 16: 25207
HONNELL, R. E., Recoil loss from ceramic fuel elements, 16: 26487 (TID-7622(p.193-206))
HOOPER, E. B., Jr., Cyclotron harmonics of a warm plasma, 16: 26418
HOPKINS, J. C., Measurements of α for monoenergetic neutrons, 16: 26510
HOPKINS, J. C., Numbers of prompt neutrons per fission, 16: 26514
HOPPES, D. D., Gamma distribution from Ce-141, 16: 26242
HORSTMAN, V. G., Effects of intradermal injections of Pu, 16: 25122 (HW-72500(p.50-1))
HORTON, J. C., Determination of Mo–U ratios in hexafluoride mixtures, 16: 25313 (K-1433)
HOWLAND, F. A., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
HOYER, G. A., Experimental cross section for $\pi^- + K\bar{K}$, 16: 26146
HRISTIDU, Yani, Aeronetic complexes of metals. LVII., 16: 25369
HRUSKA, A., Equation of plasma magnetodynamics, 16: 26420
HUBBARD, W. N., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
HUBBARD, Ward N., Fluorine bomb calorimetry. IV., 16: 25360
HUCKE, Edward E., Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
HUEBNER, J. S., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
HUGI, E., CERN 28-Gev proton synchrotron, 16: 26392
HUGUET, [F.], Absorption of Sr and Cs by plants, 16: 25642 (CEA-2159)
HULTQVIST, B., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
HULUBEI, H., Angular correlations in $S^{34}(p,p'\gamma)$, 16: 26327
HULUBEI, H., Scattering of low energy protons on S-32, 16: 26352
HUMMEL, H., Resonance scattering in light elements, 16: 26521
HUMMEL, H. H., Reactivity coefficients of Na, 16: 26545
HUMMEL, H. H., Stability analysis of EBR-II, 16: 26560
HUNGATE, F. P., Uptake of arsenate by barley plants, 16: 25138 (HW-72500(p.119-22))
HUNG-KUI, Su, Determination of Ac-225 and Ac-226 produced in U and Th bombardment, 16: 25411 (JINR-P-978)
HUNT, J. G., Texture in hot-extruded BeO, 16: 25789
HUNTER, C. H., WHY—one-dimensional few-group diffusion code for IBM 1620, 16: 26195 (KAPL-M-CT-1)
HUNTINGTON, H. B., Correlations for vacancy diffusion, 16: 25992
HURST, G. S., Quasi-trapping of electrons in water vapor, 16: 25973
HUTCHINS, B. A., Doppler effect in fast oxide reactor, 16: 26561
HUXLEY, L. G. H., Motions of electrons in gases, 16: 26034
HUZINAGA, Sigeru, Field theory for electrons in solids, 16: 26015
HYDE, Bruce, Prog. rpt. on rare earth oxides, 16: 25323 (TID-16350)
HYMAN, Herbert H., Separating actinide and lanthanide metal values, 16: 25495

I

IBERSON, E., Liquid metals. V., 16: 25782
ICHIKAWA, Fujio, Acid leaching of Th carbide, 16: 25365
ICHIKAWA, H., Lung injuries following x-ray treatment, 16: 25160
ICHIKAWA, Michio, Thermal cycling effect of U, 16: 25766 (AEC-tr-5076)
ICHINOHE, T., Phosphorus-32 excretion in bile in rabbits, 16: 25156
IDENO, Kozumi, JAERI neutron crystal spectrometer, 16: 25557 (JAERI-1030)
IGARI, S., Changes of plasmin activity caused by radiation treatment, 16: 25161
IGI, Keiji, π-N scattering length, 16: 26153
IGNATENKO, A. E., Anomalies in μ^- meson decay in paramagnetic metals, 16: 26080 (JINR-P-972)
IGUCHI, Y., Effects of OX substance on mitotic phase, 16: 25228
IGUCHI, Y., Unsaturated fatty acid from x-irradiated rabbits, 16: 25225
IHNAT, Michael E., Reaction of glasses, graphite, and refractories with Na, 16: 25318 (RAD-TM-60-44)
IKEDA, Mineo, Solutions of the Yang-Mills field, 16: 26449
IKEUYE, K. K., Brazing BeO to graphite, 16: 25739
IMAI, Hisashi, Acid leaching of Th carbide, 16: 25365
INGRAM, A. G., Effect of Zr on Ti–Al, 16: 25820
INGALLS, R. B., ESR in tritium–polystyrene fluff system, 16: 25433
INGALLS, R. B., Radiolysis of toluene, 16: 25412 (NAA-SR-6734)
INGHRAM, Mark, Photoionization of alkyl free radicals, 16: 25435
INGRAHAM, R. L., Stoichastic Lorentz observers and divergences, 16: 26444
INGRAM, D. J. E., Electron resonance studies on irradiated AgBr, 16: 25867
IPPOLITO, F., Mineralization of U, 16: 25634 (CNEN-53)
IRIE, H., Gonad exposure in I-131 thyroid function test, 16: 25668
IRISH, E. R., Prog. rpt. on radioactive residues, 16: 26639 (HW-73412)
ISAEV, P. S., Effects of π-σ interaction on S- and p-waves in π-N scattering, 16: 26076 (JINR-P-938)
ISMAIL, A. Z. M., Decay of a He hypernucleus, 16: 26307
ISSEROW, S., Prog. rpt. on power reactors, 16: 25735 (NMI-7251)
IVANITSKII, A. M., Electroencephalogram of irradiated rabbits, 16: 25203
IVANITSKII, A. M., Investigations of brain of rabbits exposed to x radiation, 16: 25244
IVANOV, M. I., Heat of formation of compounds of Pu with Al and Fe and of

U with Fe, 16: 25834
IVANOV, V. E., Vapor pressure of U compounds, 16: 25371
IVASCU, M., Angular correlations in $S^{34}(p,p'\gamma)$, 16: 26327
IVASCU, M., Scattering of low energy on S-32, 16: 26352
IVINS, Richard O., Distillation of UF_6 and BrF_3, 16: 25467 (ANL-6362)
IZOME, S., Chemical agents against radiation injuries. I., 16: 25256
IZYUMOV, Yu. A., Scattering of neutrons in helical magnetic structure, 16: 26188
IZZO, H. F., Blood cell scanner, 16: 25568 (NYO-9644)

J

JACKLYN, R. M., Sidereal and anti-sidereal daily variations of cosmic ray intensity, 16: 26054
JACKSON, R. J., Tantalum–Zr alloy system, 16: 25823 (IS-320)
JACOBS, I. S., Spontaneous magnetization in solid bodies, 16: 25882 (ASD-TR-61-630)
JACOBSON, Lillian E., Scans of brain tumors, 16: 25102
JACOBSON, M. I., Properties of Be sheet, 16: 25812
JACQUES, R., Concentration control in isotope separation plant, 16: 25686 (CEA-2160)
JACROT, B., Optical frequencies of CeF_3, 16: 25978
JAFFEE, R. I., Effects of solutes on refractory metals, 16: 25751 (DMIC-Memo-155)
JAGER, P., Polymerization of p-N,N-dimethylaminostyrene, 16: 25425
JAKOVLEV, U. P., Light fragmentation products and fission at high energies, 16: 26329
JAKUBOWSKI, Ryszard, Pulse integrators for radiation tests, 16: 25591
JAMES, M. F., Cermet and ceramic fast systems, 16: 26552
JANOSSY, L., Inelastic (n,p) cross section, 16: 26252
JANOUCH, F., Capture of polarized μ^- mesons by atomic nuclei, 16: 26236
JANSEN, A., Behavior of fast breeders, 16: 26546
JANSEN, J. F. W., Excited states of Ag-107, 16: 26280
JASINSKI, Wladyslaw, Treatment of radiation sickness, 16: 25259
JELINEK, F. J., Heat capacity anomaly in Th, 16: 25993
JENKIN, J. G., Half lives of C-10 and Ne-19, 16: 26244
JENKINS, V. K., Radiation-induced myeloid leukemias of RF mouse, 16: 25199
JENKINS, William J., Dissolving Pu metal in sulfamic acid, 16: 25310 (DP-737)
JEPSON, W. B., Oxidation of Be, 16: 25725
JERONYMO, J. M. F., Reaction $Li^7(p,\alpha)n$, 16: 26262
JOBES, F. C., Detection of twenty positron-emitting sources, 16: 25571 (TID-16268)
JODRA, L. G., Systems of H_2SO_4 solutions of U and anionic resin, 16: 25330
JOERGENSEN, M., Search for β^- decay of Hf-180m, 16: 26255
JOHANSSON, Erik, Neutron spectra with fast chopper, 16: 25586
JOHNS, Gordon L., FICS, for computing few-group constants within KARE diffusion theory, 16: 26196 (KAPL-M-RPC-3)
JOHNSON, Dennis R., Radiation chemistry of pentane isomers, 16: 25421 (WADD-TR-61-38)
JOHNSON, I., Thermodynamics of systems of U with Zn, Cd, Ga, In, Tl, Sn, and Pb, 16: 25397
JOHNSON, K., Present ideas on 25-Bev proton storage rings, 16: 25918 (NP-11977(p.5-20))
JOHNSON, Noah R., Nuclear levels of Ge-74, 16: 26283
JOHNSON, R. C., Deuteron stripping reactions, 16: 26284
JOHNSON, R. R., Radiation-induced myeloid leukemias of RF mouse, 16: 25199
JOHNSON, T. R., Dissolution of U in U–U oxides, 16: 25483 (UAC-4745)
JOHNSON, William, Carbon articles, 16: 25742
JOHNSON, William, Manufacturing C articles, 16: 25743
JOLY, R., Measuring cross sections in fast reactors, 16: 26506
JONES, G. H. S., Comments on cratering, 16: 25503 (NP-11816)
JONES, G. H. S., Ground displacement from surface burst, 16: 25087 (NP-11817)
JONES, L. V., Plutonium-bearing glass for reactor fuel, 16: 26478 (TID-7622(p.86-97))
JONKE, Albert A., Dissolving U–Zr, 16: 25710
JONSSON, Erik, Neutron spectra with fast chopper, 16: 25586
JOOS, P., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
JOOS, P., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37 (p.76-80))
JORDAN, W. B., Thermal transport equation, 16: 25524 (KAPL-2206)
JOSEPH, L., Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
JUREWICZ, A., Photoproduction amplitudes of pions on nucleons. II., 16: 26094
JURKIEWICZ, J., Radioactivity of air in Cracow, 16: 25620
JUTILA, John W., Immunization of the A/Jax mouse, 16: 25108

K

KACMAREK, Andrew J., Properties of Li ozonide, 16: 25338
KADYK, John A., Form factors in K_{e3} and $K_{\mu 3}$ decay, 16: 26135
KAELD, L., Gamma-gamma cascades of Dy-160, 16: 26346
KAES, G., Measurements of pulse controlled iron cores, 16: 25969
KAFALAS, J. A., Superconducting Nb_3Sn, 16: 25803
KAIRAITIS, D., Solvent extraction of mono(silicylato)beryllium, 16: 25486
KALBFLEISCH, George R., Strange-particle resonant states, 16: 26134
KALINOVA, R. S., Hygienic evaluation of construction materials and deactivating agents, 16: 25660 (JPRS-13691(p.8-12))
KALISH, Herbert S., Corrosion resistance of Zy-2, 16: 25726
KALISH, Herbert S., Evaluation of UO_2–stainless steel core materials, 16: 25762 (SCNC-264)
KALLMANN, Hartmut P., Prog. rpt. on radiation-induced phenomena, 16: 25413 (NP-11882)
KALYADA, T. V., Conditions of super-high frequency EM field irradiation, 16: 25662 (JPRS-13691(p.20-4))
KAMEFUCHI, S., Field quantization and statistics, 16: 26443
KANARIS, A. D., Proton bombardment of He-3 and H-3, 16: 26260
KANAYA, Koichi, Alinement in electron beam instruments, 16: 25580
KANAZAWA, A., N/D method, 16: 26132
KANEMASA, Y., Effect of radiation on bacteria. II., 16: 25223
KANER, E. A., Interaction between electron beam and EM waves, 16: 25963 (JPRS-13656(p.193-218))
KANG, Yong-ho, Hydrogen counter for H-3, 16: 25592
KANIA, A., Fast power reactors, 16: 26551
KANIA, A., Neutron-flux propagation in fast reactors, 16: 26531
KANIA, A., Physical research on RAPSODIE, 16: 26569
KANISE, I., Mixing velocity in powder mixes, 16: 25512 (NP-tr-887)
KANTELE, J., Activation cross sections for 14.7-Mev neutrons, 16: 26268
KAPIL, S., Accident analyses for fast assemblies, 16: 26565
KAPORSKII, A. V., Free-electron density in the ionosphere, 16: 26001
KAPUY, E., Model for N-electron systems, 16: 26119
KARELIN, V. V., Vapor pressure of Sc, 16: 25778
KARELINA, V. V., Vapor pressure of metallic Y, 16: 25405
KARGIN, V. A., X-ray-induced polymerization of acetaldehyde, 16: 25461
KARMEN, Arthur, Measuring radioactivity in gas chromatography effluents, 16: 25428
KARZAS, W. J., EM radiation from nuclear explosion in space, 16: 25636
KASHIWAMURA, Shohei, One-dimensional lattice with an isotopic impurity 16: 26014
KATAZUME, Mitsuyuki, Capture γ rays from infinite slab, 16: 26202 (AEC-tr-5077)
KATO, M., Bone marrow of radiation-injured guinea pigs, 16: 25204
KATO, W. Y., Argonne fast critical facility (ZPR-VI), 16: 26526
KATSURAGI, Satoru, Thermalization and diffusion of neutrons, 16: 26206
KAUFMAN, Alvin B., Field-effect transistors and radiation, 16: 25860
KAUFMAN, David, Adsorption of U, 16: 25465 (ACCO-26)
KAUFMAN, William M., Stage pulse counter apparatus, 16: 25601
KAUFMANN, S.G., Physical research on RAPSODIE, 16: 26569
KAUL, O. H., Angular distribution of $Na^{23}(n,\alpha)F^{20}$, 16: 26245
KAWA, Walter, Hydrogenation of irradiated coal, 16: 25408 (BM-RI-6022)
KAWAHARA, F. K., Residual contamination of clothing and materials, 16: 25656 (USNRDL-TR-557)
KAWASAKI, Kyozi, Theory of ferromagnetic spins, 16: 26013
KAWATRA, M. P., Mechanics of a many-body system, 16: 26168
KAYE, S., Prog. rpt. on solar cells, 16: 25845 (NP-11759)
KAZACHKONSKII, O. D., Physical characteristics of the BR-5, 16: 26567
KAZACHKOVSKII, O. D., Plutonium in nuclear power development, 16: 26609

KAZANJIAN, A. R., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
KAZARNOVSKII, M. V., Scattering of slow neutrons in crystals, 16: 26203 (AEC-tr-5145)
KAZUNO, M., High-energy nuclear interaction, 16: 26296
KEATEN, R. W., Control rod calibrations for SRE, 16: 26597 (NAA-SR-6585)
KECKI, Zbigniew, Radiation yield of hydrogen in deaerated "Neda", 16: 25416 (PAN-289/ChR)
KEENEY, W. P., Results with metallic and ceramic fuels, 16: 26524
KELLER, Donald L., Fuel from alumina-coated UO_2 particles, 16: 25749 (BMI-1586)
KELLER, Donald L., Prog. rpt. on UN, 16: 25839 (BMI-X-197)
KELLER, H. W., Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
KELLEY, J. G., Scattering of O ions from Ar and Xe, 16: 25990
KELLNER, G., High-energy elastic scattering, 16: 26122
KEMENY, L. G., Core kinetics of fission reactors, 16: 26501
KENYON, I. R., Decay of a He hypernucleus, 16: 26307
KERIMOV, B. K., Polarizable properties of electrons of μ^{+3} meson disintegration, 16: 26177
KERMAN, A. K., Description of rotating nuclei, 16: 26305
KERN, Werner, Neutron-activation study of GaAs, 16: 25293
KERR, A. C., Purification of CO_2 for reactor. III., 16: 25299 (AAEC/E-86)
KERR, R. E., PERT—Program evaluation and review technique, 16: 25081 (CRIO-1091)
KERTESZ, Laszlo, Problems of radioiodine metabolism, 16: 25105
KERTESZ, Laszlo, Tracing of metal sulfide colloid in rabbit, 16: 25104
KESSELRING, Kenneth A., Reactors and control means therefor, 16: 26578
KETELLE, B. H., Polarization of β following P-32 decay, 16: 26259
KEY, A. W., Decay of a He hypernucleus, 16: 26307
KEYSTON, J. R. G., Phase separation of He-4 in He-3, 16: 25976
KHANNA, F. C., Beryllium-9 in cluster model, 16: 26272
KIHLBERG, A., Quantal N-particle problem, 16: 26441
KILDAL, A., Landau damping, 16: 26413
KIMURA, Toshiei, Consistency of Hamiltonian formalism, 16: 26451
KING, R. D., Liquid film and pressure drop studies in annular two-phase flow, 16: 25520 (AERE-R-3921)
KINNEY, W. E., Monte Carlo calculation of scattered neutron fluxes, 16: 26200 (ORNL-3287)
KINSEY, K. F., $\pi^- + p \rightarrow \pi^0 + n$ charge exchange cross sections, 16: 26127 (NYO-9545)
KIRICHENKO, G. S., Ion beam through plasma, 16: 26427
KIRILLIN, V. A., Enthalpy of W, 16: 25779
KIRILLOV-UZRYUMOV, V. G., Elastic π^- meson scattering on C, 16: 26365
KIRKPATRICK, M. E., Phase relationships in Ni–Zr and Ni–Hf, 16: 25819
KIRSHENBAUM, A. D., Density of liquid Fe, 16: 25825
KIRSIPU, T. V., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
KISHKIN, S. T., Strength of alloys in contact with Na, 16: 25720 (FTD-TT-61-31(p.41-59))
KITABATAKE, T., Acute U poisoning, 16: 25158
KITABATAKE, T., Off-springs of x-ray workers, 16: 25214
KITADA, S., Radiation damage of the gonads, 16: 25233
KITAGAWA, O., Doubling radiation dose in genetics, 16: 25210
KIVELSON, M. G., Collision damping of plasma oscillations, 16: 26416
KIVY-ROSENBERG, E., Histochemical and biological alterations following irradiation, 16: 25175 (TID-16051)
KJELBERG, A., Radiochemical studies of isotopes of Sb and Sn, 16: 25442
KLADNITSKAYA, E. N., Production of ΛK^0 and $K^0\bar{K}^0$ pairs in $\pi^- p$ interactions, 16: 26068 (JINR-D-965)
KLAUZEN, N. A., Gamma-induced degradation of butyl rubber, 16: 25869
KLECZEK, J., Cosmic magnetohydrodynamics, 16: 26051
KLEIN, Abraham, Description of rotating nuclei, 16: 26305
KLEIN, E., Photographic film-plate for measuring radiation, 16: 25574 (AEC-tr-5193)
KLEIN, Nathan, Broad range chemical dosimeter, 16: 25561 (NDL-TR-7)
KLEIN, Ralph, Vacuum photolysis of solid ethane, 16: 25437
KLODT, Donald T., Equilibria in Y–Al system, 16: 25814
KLODT, Donald T., Prog. rpt. on scavenging W and Mo, 16: 25696 (DRI-2010)
KNAPP, D. E., $\pi^- + p \rightarrow \pi^0 + n$ charge exchange cross sections, 16: 26127 (NYO-9545)
KNOCH, Werner, Extraction of U, Pu, Ru, Zr, 16: 25482 (AEC-tr-5197)
KNOFF, Joergen B., Irreversible processes and plasma physics, 16: 26415
KNUTH, W., Drives for regulating rods in reactors, 16: 26499
KOBAYAKAWA, Keizo, Approach to multiple meson production, 16: 26170
KOBAYASHI, K., Mechanism of ultrasonic therapy, 16: 25219
KOBAYASHI, Yutaka, Prog. rpt. on biologically active amines, 16: 25176 (TID-16113)
KOBZAREV, I. Yu., New particles and Sakata model, 16: 26187
KODA, S., Behavior of inclusions in Be, 16: 25784
KOEHLER, J. S., Point defects in deformed f.c.c. metals, 16: 25764 (TID-16222)
KOESTER, Eberhard, Apparatus for measuring electrical resistance, 16: 25769 (SCL-T-434)
KOJIMA, K., Therapeutic agents against radiation injury, 16: 25253
KOKOROPOLOUS, Panos, Prog. rpt. on rare earth oxides, 16: 25323 (TID-16350)
KOLAT, R. S., Rare earth chelates of EDTA, 16: 25337 (IS-297)
KOLB, Alan C., High-temperature shock waves, 16: 26029
KOLBA, Verne M., Boiling-water nuclear reactor, 16: 26581
KOL'GA, V. V., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
KOL'GA, V. V., Nonlinear resonances in relativistic cyclotron, 16: 26372 (JINR-P-931)
KOLODZIEJCZAK, Jerzy, Thermoelectric power of Ge bombarded by fast neutrons, 16: 25852 (PAN-318/I-B)
KOLOMETSEVA, I. A., Nervous system activity in rats exposed to x radiation, 16: 25240
KOMAREK, K., Thermodynamic properties of Zr–O, Ti–O, and Hf–O alloys, 16: 25384
KONDO, S., Radiation effect on rainbow trout, 16: 25213
KONIJN, J., Half lives of He-6, N-16, O-19, F-20, Al-28, Se-77m, and Ag-110, 16: 26213 (AE-78)
KONISI, Goku, Analytic properties of the vertex function, 16: 26450
KOOISTRA, L. F., Fatigue research on pressure vessels, 16: 25607
KOONTZ, H. V., Effect of DNP on Ca accumulation and transpiration, 16: 25140 (HW-72500(p.128-33))
KOPYTIN, L. M., Heat of formation of compounds of Pu with Al and Fe and of U with Fe, 16: 25834
KORENKOV, I. P., Sanitary-hygienic requirements of centers of radioactive isotopes, 16: 25661 (JPRS-13691(p.13-19))
KORNBERG, H. A., Prog. rpt. on biology, 16: 25111 (HW-72500)
KORNILOV, A. N., Heats of formation of Nb_2O_5 and Ta_2O_5, 16: 25334
KORNILOV, I. I., Metallochemistry and its problems, 16: 25702 (AEC-tr-5182)
KOROBKOV, V. I., Geochemistry of U and Th, 16: 25627
KOSUT, B. S., Uranium swelling studies, 16: 25840 (HW-65453)
KOTANI, Tsuneyuki, Beta-decay of Λ and Σ^- hyperons, 16: 26167
KOTHSTEIN, Thomas F., Nuclear pulse testing of camera heads, 16: 25836 (AD-270724)
KOTOV, V. V., Motion of electrons in magnetic system, 16: 26391 (FTD-TT-61-242(p.167-82))
KOVACH, P., Joining of refractory metals—W, 16: 25737 (WAL-TR-460.54/1-2)
KOVALENKO, S. S., Kinetic energy of fragments emitted in fission of U-238, 16: 26355
KOVALENKO, V. A., Unobserved region in photoproduction dispersion ratios, 16: 26073 (JINR-P-904)
KOVALEV, I. T., Rate of vaporization of metallic oxides, 16: 25403
KOVALEV, V. P., Fission threshold fragment excitation energies in drop model, 16: 26361
KOVTUN, G. P., Vapor pressure of U compounds, 16: 25371
KOYAMA, G., Excretion of P-32, 16: 25163
KRAFT, Rose, Bibliography on analyses of Pu and Pu alloys, 16: 25273 (UCRL-6873)
KRAMER, Gustav, Nucleon-nucleon triplet-even potentials, 16: 26126 (UCRL-9904)
KRAMER, P., Decay of Mn-54, Zn-65, and Co-57, 16: 26336
KRAMER, P., Decay of Co-58, 16: 26337
KRAMER, P., Fluorescence yield of Cr, Mn, Cu, and Ga, 16: 26000
KRAMERS, H., Fluidization applied to thermostatic bath, 16: 25513 (NP-9

1957)
KRATOCHVILOVA, K., Influence of radiation on piezoelectric resonators, 16: 25857
KREBS, K. H., Recording of pulse-height distribution, 16: 25583
KREISMAN, Wallace S., Vacuum gage calibration, 16: 25553 (GCA-TR-61-19-N)
KREY, Philip W., Plutonium in man, 16: 25171
KRISTENSEN, P., Dynamical laws in quantum theory of fields, 16: 26438
KROH, Jerzy, Radiation chemistry of water, 16: 25462
KRONMER, Jack S., Scintillation scanning of the liver. I., 16: 25098
KRONMER, Jack S., Scintillation scanning of the liver. II., 16: 25099
KROHN, J., Ground displacement from surface burst, 16: 25087 (NP-11817)
KROLIKOWSKI, W., About the strangeness of leptons, 16: 26099
KROLIKOWSKI, W., Rotational symmetry of universal Fermi interaction, 16: 26109
KROPIN, A. A., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
KRUG, H., Evaluation of U^{235}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
KRUGLIKOV, R. I., Unconditioned and conditioned reflex in irradiated rabbits, 16: 25242
KRUGLYKH, A. A., Vapor pressure of U compounds, 16: 25371
KRUMMEL, D. E., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
KRUTIKOV, A. B., Chemistry and production of U fluoride compounds, 16: 25470
KRZHIVANEK, M., Determination of Ac-225 and Ac-226 produced in U and Th bombardment, 16: 25411 (JINR-P-978)
KUBASCHEWSKI, O., Free-energy- and phase-diagrams, 16: 25374
KUCHOWICZ, B., Homogeneous Lorentz group. I., 16: 25966
KUCZYNSKI, Georges C., Sintering theory, 16: 25698 (NP-11636)
KUDRYASHOV, Yu. B., Action of radiomimetic agent on yeast cells, 16: 25200
KULIKOV, O. F., Size of electron bunch during operation of synchrotron, 16: 26105
KULIKOVSKAYA, E. (Ye.) L., Conditions of super-high frequency EM field irradiation, 16: 25662 (JPRS-13691(p.20-4))
KUMAR, Kailash, Perturbation theory and the many-body problem, 16: 26023
KUMMER, W., Phases of proton's EM form factors, 16: 26112
KUNKEL, William P., Computer analysis of loss-of-coolant accident, 16: 26587 (CVNA-117(Vol.I))
KUNKEL, William P., Computer analysis of loss-of-coolant accident, 16: 26588 (CVNA-117(Vol.II))
KUNZMAN, J. A., Response requirements for radiacs. III., 16: 25572 (USNRDL-TR-567)
KUPPERMANN, Aron, Theory of periodic deviations in Schottky effect, 16: 25954 (TID-16225)
KUPTSOV, A. V., Anomalies in μ^- meson decay in paramagnetic metals, 16: 26080 (JINR-P-972)
KURODA, Y., Radiation cancer, 16: 25201
KURT, P. G., Potential of a metal sphere in space, 16: 26050
KUSNETSKII (KUSNETSKIY), V. V., Motion electrons in magnetic system, 16: 26391 (FTD-TT-61-242(p.167-82))
KUSZELL, A., Multi-group neutron transport theory, 16: 26538
KUZMINSKI, A. S., Radiation vulcanization of silicone rubber, 16: 25684
KUZMYAK, M., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
KUZNETSOV, A. A., Production of ΛK^0 and $K^0\bar{K}^0$ pairs in π^- p interactions, 16: 26068 (JINR-D-965)
KUZNETSOV, E. P., Resonance in a $K^0\Lambda^0$ system at 1650 Mev, 16: 26189
KUZNETSOV, E. V., Resonance in a $K^0\Lambda^0$ system at 1650 Mev, 16: 26189
KUZNETSOV, V. M., Controlled ground explosion, 16: 25640
KUZNETSOVA, M. Ye., Reaction $Al^{27}(p,p\pi^+)Mg^{27}$, 16: 26354
KUZOVKOV, N. T., Automatic control systems containing linear elements with variable parameters, 16: 25510 (DEG-Inf-Ser-262)
KVLIVIDZE, V. I., Nutation in experiments on nuclear magnetic resonance, 16: 25965 (JPRS-13656(p.260-78))

L

LAAKSO, I., Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
LACAZE, Albert, Neutron moderation, 16: 26193 (CEA-2012)
LACOMBE, Paul, Growth of large perfect crystals of α U, 16: 25329 (AEC-tr-5249)
LADNER, Hugh A., Abrasive tests on ion exchange resins, 16: 25497 (ACCO-66)
LAHNERS, E. L., Radioisotope accountability system, 16: 25663
LALL, P. C., Directional correlation in Ti-46, 16: 26256
LAMB, Vernon A., Coatings for refractory metals, 16: 25701 (WADD-TR-61-64)
LAMBERT, J. D., Relaxation in gases, 16: 26044
LAMBERT, J. L., Structures in binary salt solutions, 16: 25358
LANE, A. M., Isotopic spin purity in heavy nuclei, 16: 26304
LANE, A. M., Quasi-elastic (p,n) reactions, 16: 26285
LANG, Sidney B., Coalescence of liquid drops, 16: 25956 (UCRL-10097)
LANGHORST, Arthur L., Jr., Bibliography on analyses of Pu and Pu alloys, 16: 25273 (UCRL-6873)
LANGROD, K., Ceramic internal reflector for SNAP-8, 16: 25734 (NAA-SR-7293)
LANTZ, P. M., Thermal cross section and resonance capture of Ce-144, 16: 26294
LAPOSTOLLE, P., HF-type particle separators, 16: 26369 (CEA-2109)
LARK, N. L., Excited states of Ag-107, 16: 26280
LARSEN, W. L., Phase relationships in Ni–Zr and Ni–Hf, 16: 25819
LARSEN, W. L., Tantalum–Zr alloy system, 16: 25823 (IS-320)
LARSON, J. B., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
LASSEN, N. O., Recoil ions from α reactions, 16: 26243
LATTA, Harrison, Changes across irradiated rat intestinal villi, 16: 25180 (TID-16271)
LATTER, R., EM radiation from nuclear explosion in space, 16: 25636
LAUGHLIN, J. S., Production and properties of high-energy electrons, 16: 25188
LAVAKARE, P. J., Spurious scattering in nuclear emulsions, 16: 26090 (NYO-10233)
LAVINE, M. C., Superconducting Nb,In, 16: 25803
LAWRENCE, L. G., Reaction $Mg^{26}(p,\alpha)Na^{23}$, 16: 26310
LAWROSKI, Stephen, Reactor Fuel Processing, Vol. 5, No. 2, 16: 25493
LEACH, L. J., Changes in pigeon following inhalation of Hg vapor, 16: 25154 (UR-578)
LEACH, S. J., Studies of protein structure, 16: 25332
LEARY, J. A., Method for obtaining Pu metal, 16: 25711
LEARY, J. A., Preparation of UC–PuC solid solutions, 16: 25706
LEBEDEV, Ye. S., Free radical reactions in irradiated polytetrafluoroethylene. III., 16: 25460
LEDERMAN, L. M., Existence of two kinds of neutrinos, 16: 26147
LEE, T. D., Neutrino reactions without boson production, 16: 26130
LE GARDEUR, Rene, Reduction of scattering losses and containment, 16: 26408
LEGGETT, R. D., Uranium swelling studies, 16: 25840 (HW-65453)
LEIPUNSKII, A. I., Physical characteristics of the BR-5, 16: 26567
LEITNER, J., Decay of negative hyperon, 16: 26141
LEMCOE, M. M., Fatigue research on pressure vessels, 16: 25607
LENCE, J. T., Calculation of neutron flux, 16: 26432 (APEX-652)
LEONARD, B. P., Magnetohydrodynamic flow about blunt body, 16: 25874 (AFOSR-2714)
LEONIDOV, V. Ya., Heats of formation of Nb_2O_5 and Ta_2O_5, 16: 25334
LEONTEV, V. G., Cesium and Sr in human organs, 16: 25157
LERNER, M. W., Determination of Zr in Th–Zr alloys, 16: 25284
LEROY, J. R., Measuring cross sections in fast reactors, 16: 26506
LESAGE, J., Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
LEUTNER, Hans, Concerning Na_3UF_8, 16: 25328 (AEC-tr-5205)
LEVEQUE, A., π^+-p elastic scattering, 16: 26120
LEVIN, V. A., Unstable flow of charged gas, 16: 26431
LEVINE, Harold H., Prog. rpt. on high-temperature adhesives, 16: 25699 (NP-11815)
LEVINE, M. M., Fission-product burnup in fast reactors, 16: 26548
LEVITSKII (LEVITSKIY), S. M., Current oscillations in thermionic energy converter, 16: 25957 (FTD-TT-62-637)
LEVITZ, Norman M., Dissolving U–Zr, 16: 25710
LEWIS, Paul S., Hydrogenation of irradiated coal, 16: 25408 (BM-RI-6022)
LEWIS, R. A., Control rod calibrations for SRE, 16: 26597 (NAA-SR-6585)

LIAS, S., Gas-phase radiolysis of propane, 16: 25434
LIGUORI, R. R., Calculation of neutron flux, 16: 26432 (APEX-652)
LILLETHUN, E., Nucleon-nucleon total cross sections, 16: 26145
LIM, E. C., Radiative lifetime of $^3B_{1u}$ state of benzene, 16: 25436
LIN, C. C., Hydrodynamics of He II, 16: 25911 (NP-11813)
LINDAHL, G., Effective resonance absorption integrals for Zr and Nb, 16: 26511
LINSON, Lewis M., Thermal effects on plasma dispersion, 16: 26398 (AD-270033)
LIPKIN, H. J., Transverse polarization of conversion electrons following β decay, 16: 26086 (NP-11737)
LIPPERT, J., Environmental radioactivity in Denmark, 1961, 16: 25169 (RISÖ-41)
LISZKA, L., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
LITTLE, W. A., Transition temperature of a superconducting cylinder, 16: 25998
LIU, Y. S., ρ-particle contribution to π-N scattering, 16: 26114
LIVEY, D. T., Lattice parameter and density of BeO, 16: 25783 (AERE-R-3774)
LIVINGSTON, J. D., Dispersion hardening, 16: 25693 (ARL-62-357)
LIVSHITS, N. N., Effects of radiation on nervous system, 16: 25235
LLOYD, P. J., Solvent extraction in U industry, 16: 25490
LOCK, D. N., Radiochemical examination of errors in mine assaying, 16: 25635
LOCK, W. O., Production of pion pairs by 14 Gev/c pions, 16: 25927 (NP-11977(p.66-7))
LOCKWOOD, Paul A., Nuclear fuel-bearing glasses, 16: 26477 (TID-7622 (p.74-85))
LOFSTROM, James E., Responses of rat embryos to radiation, 16: 25231
LOINGER, A., Quantum theory of measurement, 16: 26439
LOKANATHAN, S., Decay of a He hypernucleus, 16: 26307
LOKANATHAN, S., Example of $_{\Lambda}Be^7$ hypernucleus, 16: 26312
LOMBARDO, J. J., Control rod material, Ag–In–Cd, 16: 25796
LOMNEV, S. P., Equation of motion of particle in betatron, 16: 26386 (FTD-TT-61-242(p.129-33))
LOMNEV, S. P., Focusing particles by magnetic field in linear electron accelerator, 16: 26380 (FTD-TT-61-242(p.33-6))
LOMNEV, S. P., Focusing beam of particles in linear electron, 16: 26381 (FTD-TT-61-242(p.37-42))
LOMNEV, S. P., Motion of particle in electromagnetic field, 16: 26377 (FTD-TT-61-242(p.1-2))
LOMNEV, S. P., Oscillations of particles in linear electron accelerator, 16: 26378 (FTD-TT-61-242(p.3-21))
LOMNEV, S. P., Particle dynamics in linear electron accelerator, 16: 26382 (FTD-TT-61-242(p.43-5))
LOMNEV, S. P., Power carried by accelerating harmonic in linear electron accelerator, 16: 26383 (FTD-TT-61-242(p.46-53))
LOMNEV, S. P., Trajectory of particles in linear electron accelerator, 16: 26379 (FTD-TT-61-242(p.22-32))
LONG, Everett, Fluid flow control systems, 16: 25538
LONG, J. J., RACHEL critical assembly, 16: 26527
LONG, J. K., Results with metallic and ceramic fuels, 16: 26524
LOPEZ, B., Systems of H_2SO_4 solutions of U and anionic resin, 16: 25330
LORENZ, R. A., Release of fission products on in-pile melting of reactor fuels, 16: 26488 (TID-7622(p.207-15))
LORENZINI, L., Determination of rare earths in U compounds, 16: 25266 (CNEN-135)
LORENZONI, S., Mineralization of U, 16: 25634 (CNEN-53)
LOSKUTKOV, Yu. M., Polarizable properties of electrons of μ^2 meson disintegration, 16: 26177
LOSTY, H. H. W., Irradiation creep experiments on graphite springs, 16: 25870
LOVE, D. L., Gamma spectra of Te-133m and Te-134, 16: 26239
LOVEGROVE, P. C., Liquid film and pressure drop studies in annular two-phase flow, 16: 25520 (AERE-R-3921)
LOVITCH, L., Spectral representation of two-point function, 16: 26057
LOWDE, R. D., X-ray and neutron diffraction analysis of LiH, 16: 25800
LOWER, G. W., Elution of U from anion exchange resins, 16: 25463 (ACCO-12)
LOWER, George W., Abrasive tests on ion exchange resins, 16: 25497 (ACCO-66)
LOWERY, Andrew, Calculation of neutron flux, 16: 26432 (APEX-652)
LOZHKIN, O. V., Light fragmentation products and fission at high energies, 16: 26329
LUBY, C. S., Coating Th–U carbides with C, 16: 25731 (GA-2241)
LUESCHER, E., Hyperfine structure of atomic N, 16: 26318
LUGOVTSOV, B. A., Propagation of shock waves at remote distances, 16: 25639
LUKJANOV, W. K., Deuterium tear on noncoaxial nuclei, 16: 26350
LULKA, V. A., Decay of hypernuclei, 16: 26363
LUNDGREN, G., Effective resonance absorption integrals for Zr and Nb, 16: 26511
LUNDIN, Charles E., Jr., Equilibria in Y–Al system, 16: 25814
LUTZ, G. J., Removal of Pu from U, 16: 25474 (IS-470)
LUZ, Z., Oxidation of phosphorous acid, 16: 25361
LYAGIN, I. V., Photoproduction of charged vector meson pairs in Coulomb field, 16: 26362
LYAKHOVICH, V. V., Zirconium and Hf ratio in zircon, 16: 25629
LYASHENKO, I. N., Radiation polymerization and copolymerization of allylhydrosilanes, 16: 25459
LYMPANY, Byron B., Properties of intermetallic compounds, 16: 25748 (ASD-TDR-62-476)
LYNCH, C. T., Growth and analysis of Al_2O_3 "whiskers," 16: 25694 (ASD-TDR-62-272)
LYNCH, G. R., Data on new resonances, 16: 26158 (UCRL-10167)
LYSZCZARZ, Boleslaw, Apparatus for processing nuclear emulsions, 16: 25504 (PAN-293/I-A)
LYTKIN, V. B., Plutonium in nuclear power development, 16: 26609
LYUBIMOV, V. B., Properties of π^- mesons, 16: 26081 (JINR-P-974)

M

MABEIX, H. R., Experience with reactors EL 2 and EL 3, 16: 26626
MAC DONALD, J. E., Program 20-8, for interpreting program 18-0, 16: 26466 (GEMP-123)
MAC INTYRE, William J., Estimation of liver size, 16: 25100
MAC INTYRE, William J., Liver scanning, 16: 25190
MAC KENZIE, D. R., Fluorocarbons in reactor technology, 16: 26480 (TID-7622(p.109-20))
MAEKITALO, T., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
MAGGIO, R. C., Prog. rpt. on thermal radiation studies, 16: 25876 (AFSWP-844)
MAGIL'NEV, A. I., Kinetics of a research reactor, 16: 26557
MAHNAU, H., Thermal radiation of an atom bomb, 16: 25090
MAIMONI, A., Electrical resistance of Al, 16: 25777 (UCRL-6480)
MAIROV, A. A., Chemistry and production of U fluoride compounds, 16: 25470
MAJIMA, A., Eye abnormalities caused by x irradiation, 16: 25215
MAJUMDAR, S. Datta, Wave equations in curved space-time, 16: 25991
MAKHAN'KOV, V. G., Excitations of EM waves in plasma, 16: 26401 (JINR-P-917)
MAKINODAN, T., Bone marrow transplantation, 16: 25109
MAKINS, Roger, Nuclear power in Britain, 1962, 16: 25082 (DPR/INF/257)
MALABY, K. L., Removal of Pu from U, 16: 25474 (IS-470)
MALDAGUE, P., Production of D and other light isotopes, 16: 25688 (AEC-tr-5199)
MALINOWSKI, Wiktor, Scattering of holes in Ge by fast neutrons, 16: 2883 (PAN-315/I-B)
MALM, John G., Magnetic susceptibility of ReF_6, 16: 25347
MALMSKOG, S., Half lives of He-6, N-16, O-19, F-20, Al-28, Se-77m, and Ag-110, 16: 26213 (AE-78)
MAL'TSEVA, N. S., Production of At-209 and At-207, 16: 26220 (JINR-P-950)
MALVANO, Renzo, Analyses of Al by neutron radioactivation, 16: 25283
MALY, Yu., Determination of Ac-225 and Ac-226 produced in U and Th bombardment, 16: 25411 (JINR-P-978)
MAMBRIANI, G., Ionization measurements from H_2 bubble chamber, 16: 25921 (NP-11977(p.45-48))
MANARA, A., Conductivity in plastically deformed alkali halides, 16: 25316 (NP-11921)
MANFREDINI, A., Photoproduction of K mesons in H_2, 16: 25947 (NP-11977(p.137-9))

MAHI, G. S., Reaction $Li^7(p,\alpha)\alpha$, 16: 26262
MANN, J. E., Cermet and ceramic fast systems, 16: 26552
MANNING, G., Nucleon-nucleon total cross sections, 16: 26145
MANNING, J. A., Liquid metals. V., 16: 25782
MANNING, P. G., Recoil effects of C-14 in toluene, 16: 25438
MANTEL, M., Determination of Te in presence of Bi, 16: 25267 (IA-724)
MAPOTHER, D. E., Thermodynamic consistency of critical field, 16: 25805
MARADUDIN, A. A., Debye-Waller factor for Mössbauer impurity atoms, 16: 26316
MARAMAN, W. J., Method for obtaining Pu metal, 16: 25711
MARCAZZAN, M. G., Measurements of neutron beams, 16: 25589
MARCAZZAN, M. G., (n,α) Reactions in heavy elements, 16: 26297
MARCH, R. H., Experimental cross section for $\pi\pi \to K\bar{K}$, 16: 26146
MARCHAL, J., Action of γ rays on polyoxyethyleneglycol, 16: 25447
MARCHUK, G. I., Calculation methods for reactors, 16: 26536
MARCUM, J. I., Inference of Monte Carlo properties, 16: 25690 (RM-3134-PR)
MARGOLIN, Harold, Behavior of the Ti–8Al–8Zr–1(Ta + Cb) alloy, 16: 25813
MARGOLINAS, S., Utilization of isotopes for control apparatus, 16: 25683
MARGRAVE, J. L., High-temperature heat contents of refractory borides, 16: 25401
MARGULIES, S., Transmission and line broadening in Mössbauer effect, 16: 26225 (NP-11913)
MARICIC, S., Proton conductivity in $Li_2SO_4 \cdot H_2O$, 16: 25333
MARINELLI, G., Mineralization of U, 16: 25634 (CNEN-53)
MARINI, G., Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37 (p.105-9))
MARINSKY, J. A., Nuclear levels of Ge-74, 16: 26283
MARIS, Th. A. J., Effect of perturbations on angular correlations, 16: 26250
MARISH, C., Pion-pion production, 16: 26104
MARKHAM, Jordan J., Prog. rpt. on magnetic properties of insulators, 16: 25838 (ARF-1184-5)
MARKIN, T. L., Thermodynamic data for U oxides, 16: 25377
MARKO, A. M., Decontamination of buildings, 16: 25498 (AECL-1531)
MARKOV, M. A., Regularization method in field theory, 16: 26434 (JINR-E-977)
MARKS, S., Delayed effects of Y-90 ingestion, 16: 25131 (HW-72500 (p.88-91))
MARONI, C., Parity conservation pion production, 16: 25889 (LNF-62/37 (p.13-23))
MARONI, C., Parity conservation in the reaction $\gamma + p \to \pi^+ + \pi^- + p$, 16: 25944 (NP-11977(p.127-9))
MARQUES, Branco Ednes, Separation of chemical elements, 16: 25278 (SCL-T-423)
MARQUEZ, L., Reaction $C^{14}(Li^6,\alpha)N^{16}$, 16: 26249
MARSHALL, R. R., Ages of Fe meteorites, 16: 25614 (JPL-TR-32-147)
MARTALOGU, N., Angular correlations in $S^{32}(p,p'\gamma)$, 16: 26327
MARTALOGU, N., Scattering of low energy photons on S-32, 16: 26352
MARTI-BALAGUER, C., Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
MARTIN, J. V., Solvent extraction of Be, 16: 25475 (NCL/AE-172)
MARTIN, W. J., Fission products from reactor-grade UO_2, 16: 26484 (TID-7622(p.149-59))
MARTINEZ, A. M., Studies on radioactive precipitation, 16: 25674
MARUYAMA, M., Angular distributions of fast neutrons, 16: 26507
MASHBURN, J. C., Airborne contamination control, 16: 25509 (TID-16274)
MASON, Edward A., Scattering of atoms, molecules, and ions, 16: 26041
MASSALSKA, M., Radioactivity of air in Cracow, 16: 25620
MASTERSON, K. S., Probe theory in dense plasma, 16: 26405 (UCRL-10128)
MASUDA, Naohiro, ω-N interaction and $p + \bar{p} \to \omega + \omega$ reaction, 16: 26175
MATHE, Georges, Treatment of subjects irradiated accidentally, 16: 25184 (SCL-T-424)
MATHER, D. S., Prompt neutrons from U-235 fission, 16: 26513
MATLOCK, R.G., Stability of EBR-I, 16: 26558
MATSUDA, Hiroteyu, Green's function of particle in one dimension, 16: 26172
MATSUMOTO, Tokutoro, Junior cave for chemical procedures, 16: 25260 (JAERI-1029)
MATSUOKA, R., Radiation cancer, 16: 25201
MATSUZAKI, Yoshio, Pion-hyperon resonance, 16: 26161
MATTHEWS, C. O., Properties of Be sheet, 16: 25812
MATTHEWS, P. T., Regge poles and diffraction scattering, 16: 26154
MATTHEWS, P. T., Unitary symmetry, 16: 26156
MATTHIAE, G., Capture of π^- mesons in complex nuclei, 16: 25902 (LNF-62/37(p.138-42))
MATTHIAE, G., Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))
MAUTE, Robert L., Liquid scintillation counting of H-3, 16: 25429
MAY, Sherman L., Separating Ta and Nb, 16: 25492
MAYNARD, E. A., Changes in pigeon following inhalation of Hg vapor, 16: 25154 (UR-578)
MAZOR, E., Radon and Ra content of Israeli water sources, 16: 25624
MAZZA, Edward N., Evaluation of UO_2–stainless steel core materials, 16: 25762 (SCNC-264)
MC BRIDE, J. P., Radiation-induced sintering of ThO_2, 16: 25848 (ORNL-3275)
MC CANDLESS, Ruth, Changes across irradiated rat intestinal villi, 16: 25180 (TID-16271)
MC CARTHY, M., Automatic control systems containing linear elements with variable parameters, 16: 25510 (DEG-Inf-Ser-262)
MC CLELLAN, R. O., Effects of Sr-90 in miniature swine, 16: 25112 (HW-72500(p.1-12))
MC CLELLAN, R. O., Effect of age on retention of Sr and Ca, 16: 25113 (HW-72500(p.13-14))
MC CLELLAN, R. O., Toxicity of Sr-90, Ra-226, and Pu-239, 16: 25119 (HW-72500(p.36-40))
MC CLELLAN, R. O., Transfer of heavy radionuclides to milk, 16: 25121 (HW-72500(p.44-9))
MC CLENDON, J. F., Radioisotope scanning of liver and spleen, 16: 25101
MC CLINTOCK, D. C., Features of Elk River Reactor, 16: 26608
MC CLURE, J. J., Probe theory in dense plasma, 16: 26405 (UCRL-10128)
MC CLURE, J. W., Isobaric states in nonmirror nuclei, 16: 26326 (UCRL-6733)
MC CORMICK, Colin Campbell, Improvements relating to mass spectrometers, 16: 25600
MC COY, W., Standard molar free energy of formation of some chlorides of Mg, Ce, U, and Th, 16: 25392
MC DONALD, R. R., Alloying additions on $\gamma \simeq \alpha$ transformation. I., 16: 25797
MC DONOUGH, John M., Properties of Li ozonide, 16: 25338
MC DUFFEE, W. T., Accountability measurements program for fuel reprocessing, 16: 25479 (ORNL-TM-288)
MC DUFFIE, H. F., Preparation of high-purity BeO, 16: 26481 (TID-7622 (p.122-7))
MC ENHILL, J. J., Integral experiments on fast systems of Pu, U, and Th, 16: 26522
MC FARLANE, E. F., Kinetics of oxidation of Li, 16: 25727
MC GINNIS, F. D., Stability of EBR-I, 16: 26558
MC ILDOWIE, J. E. G., Energy levels of B-10. II., 16: 26266
MC INTYRE, J. A., Detection of twenty positron-emitting sources, 16: 25571 (TID-16268)
MC KENNA, James, Quasi-chemical equilibrium theory, 16: 26012
MC KENNEY, J. R., Effects of Sr-90 in miniature swine, 16: 25112 (HW-72500(p.1-12))
MC KENNEY, J. R., Interrelationships of Ca, Sr, and phosphate in serum, 16: 25115 (HW-72500(p.19-22))
MC NESBY, James, Vacuum photolysis of solid ethane, 16: 25437
MC VEAH, R. L., Results with metallic and ceramic fuels, 16: 26524
MC VOY, K. W., Pair distribution functions, 16: 26440
MC WILLIAMS, A. S., Spin interaction in solid He, 16: 25981
MC WILLIAMS, J. A., Direct conversion of fission heat to electric power, 16: 25972
MEADE, P.-J., Meteorological aspects of safety and location of reactor plants, 16: 25615 (NP-11760)
MEADOWS, J., Fission properties utilized in reactor design, 16: 26512
MEADOWS, J. W., Parameters of neutrons in ZrH, 16: 26207
MEADS, R. E., Energy levels of B-10. I., 16: 26265
MEADS, R. E., Energy levels of B-10. II., 16: 26266
MECH, Joseph, Isolation of I without carrier, 16: 25264 (ANL-6577)
MEDCALF, W. E., Purification of CdS crystals, 16: 25878 (ARL-62-319)
MEGILL, L. R., Electron energy distribution in slightly ionized air,

16: 25989
MEKHEDOV, V. N., Production of At-209 and At-207, 16: 26220 (JINR-P-950)
MEL'NIKOV, V. K., Magnetic field power lines, 16: 26402 (JINR-P-929)
MENCUCCINI, C., Cross section of the process $\gamma + p \rightarrow \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
MENCUCCINI, C., Polarization of recoil protons, 16: 25939 (NP-11977 (p.111-15))
MENCUCCINI, C., Scintillation chambers, 16: 25940 (NP-11977(p.116-20))
MENCUCCINI, C., Study on the process $\gamma + p \rightarrow \eta + p$, 16: 25897 (LNF-62/37(p.89-98))
MENDES, Francisco J., Portuguese U minerals, 16: 25638
MENEGHETTI, D., Analyses of ZPR-III fast critical assemblies, 16: 26534
MENICHELLA, E. Sotta, Emission in (p,α) and (d,α) reactions, 16: 26309
MENNRATH, P., Transitions in O-16, 16: 26301
MENNRATH, P., Transition in B-11, 16: 26302
MERCER, B. W., Decontamination of wastes containing ammonia, 16: 26638 (HW-71627)
MERCIER, Jean, Growth of large perfect crystals of α U, 16: 25329 (AEC-tr-5249)
MEREDITH, R. E., Infrared absorption spectrum of CD_4, 16: 25345
MERLINI, M., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
MERTE, Herman, Jr., Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
MERZARI, F., Measurements of neutron beams, 16: 25589
MERZARI, F., (α,α) Reactions in heavy elements, 16: 26297
MESHCHERYAKOV, V. A., Edge problem in dispersion ratios, 16: 26077 (JINR-P-949)
MESHCHERYAKOV, V. A., Effects of π-σ interaction on S- and p-waves in π-N scattering, 16: 26076 (JINR-P-938)
MESHKOV, Natalia, Shell model study of Li-6, 16: 26276
MESSELT, S., Slowing down of (D,D) neutrons in paraffin wax, 16: 26210
MESSERLE, H. K., Magnetohydrodynamic power generation, 16: 26412
MESSERSMITH, J. D., Maritime GCR land-based prototype, 16: 26592 (GAMD-1722)
MESSIAEN, A. M., Resonant behavior of plasma, 16: 26419
METALLI, P., Sensitivity to x rays of *Artemia salina* leach, 16: 25198 (CNEN-117)
METH, Irving M., Effect of noise on pulse height resolution, 16: 25554 (HASL-118)
MEUNIER, J., Biological study of luminous paint, 16: 25110 (CEA-2155)
MEYER, J., π^+-p elastic scattering, 16: 26120
MEYER, L., Mobility of ions in liquid He^4I and He-3, 16: 25984
MEZAKI, R., High-temperature heat contents of refractory borides, 16: 25401
MEZZETTI, L., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
MEZZETTI, L., Photoproduction of π^+, 16: 25891 (LNF-62/37(p.34-9))
MEZZETTI, L., Photoproduction of π^+ with polarized photons, 16: 25935 (NP-11977(p.99-100))
MEZZETTI, L., Photoproduction of pions in H_2 and D_2, 16: 25943 (NP-11977(p.124-6))
MEZZETTI, L., Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
MEZZETTI, L., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37(p.76-80))
MICHAEL, P., Correlation of integral experiments and high-energy cross-sections, 16: 26532 (BNL-5604; BNL-5892)
MICHAL, S. B., Elution of U from anion exchange resins, 16: 25463 (ACCO-12)
MICHALEC, R., Polarization of cold, thermal, and resonance neutrons, 16: 26205
MICHAUDON, A., Measuring cross sections in fast reactors, 16: 26506
MIDDLETON, R., Analysis of stripping optical model parameters, 16: 26300
MIKAMI, Hisashi, Separation of isotopes by nozzle process, 16: 25687 (AEC-tr-5069)
MIKHAILOV, I. N., On $T + T \rightarrow He^4 + 2n$ reaction, 16: 26075 (JINR-P-911)
MIKHAILOV (MIKHAYLOV), L. N., Mass-spectrometer for investigating ion sources, 16: 26390 (FTD-TT-61-242(p.162-6))
MIKHAILOV, N. V., Radiation polymerization of vinyl monomer on fiber, 16: 25431
MIKHAILOVA, N. G., Conditioned reflex exposed to radiation, 16: 25239
MIKHALENKOV, V. S., Diffusion parameters in Ni, 16: 25831
MIKHUL, A., Production of ΛK^0 and $K^0\bar{K}^0$ pairs in π^-p interactions, 16: 26068 (JINR-D-965)
MIKLASHEV, V. E., Conditioned reflex exposed to radiation, 16: 25239
MIKLASHEVSKII, V. E., Conditioned reflex of white rat exposed to radiation, 16: 25238
MILES, Alfred, Induction heating application test, 16: 25605 (DC-55-11-47)
MILES, George S., Nuclear transportation accidents, 16: 25669
MILIANI, A., Intestinal absorption of I^{131}-labeled triolein, 16: 25230
MILLER, C. E., Jr., Release of fission products on in-pile melting of reactor fuels, 16: 26488 (TID-7622(p.207-15))
MILLER, C. Samuel, Prog. rpt. on scavenging W and Mo, 16: 25696 (DRI-2010)
MILLER, D., Measurement of the triple scattering parameter, 16: 26140
MILLER, Donald H., Strange-particle resonant states, 16: 26134
MILLER, M. A., Theory of surface EM waves, 16: 25959 (JPRS-13656 (p.1-91))
MILLER, Neil E., Determination of short-lived fission-product gases, 16: 25295
MILLER, Paul D., Corrosion of Th and U, 16: 25713 (BMI-1563)
MILLER, R. C., Neutron diffraction of Fe_2O_3--V_2O_3, 16: 25366
MILLER, Wade H., Scans of brain tumors, 16: 25102
MILLS, R. L., Structure of the γ form of solid He-4, 16: 25994
MILTON, J. C. D., Prompt neutrons from spontaneous fission of Cf-252, 16: 26320 (UCRL-9713(Rev.))
MILWARD, G. L., Solvent extraction of Be, 16: 25475 (NCL/AE-172)
MIN, Lu, Angular distribution of π mesons, 16: 26082 (JINR-P-981)
MINAMI, Shigeo, Heavy mesons and anomalous magnetic moments, 16: 26164
MINAMI, Shigeo, ω-N interaction and $p + \bar{p} \rightarrow \omega + \omega$ reaction, 16: 26175
MINAMI, Shigeo, Resonant states in three-pion system, 16: 26165
MINC, Stefan, Radiation yield of hydrogen in deaerated "Neda", 16: 25416 (PAN-289/ChR)
MING NAM PUK (MIN NAM BUK), Production of At-209 and At-207, 16: 26220 (JINR-P-950)
MISAWA, Setsuo, Dielectric constant of electron fluid, 16: 26423
MISSIROLI, G., Characteristics of C-14 source and versatile thickness gage, 16: 26108
MISSONI, G., Research program with "light" of Frascati synchrotron, 16: 25903 (LNF-62/37(p.142-56))
MISTRY, N., Existence of two kinds of neutrinos, 16: 26147
MITTEMPERGHER, M., Mineralization of U, 16: 25634 (CNEN-53)
MITTRA, I. S., Decay of negative hyperon, 16: 26141
MIYACHI, Yoshihiko, Solutions of the Yang-Mills field, 16: 26449
MIYAGAWA, Nobukazu, Movements of arc cathode spot, 16: 26018
MIYAKE, K., $\pi^- + p \rightarrow \pi^0 + n$ charge exchange cross sections, 16: 26127 (NYO-9545)
MIYAMOTO, Yoneji, ω-N interaction and $p + \bar{p} \rightarrow \omega + \omega$ reaction, 16: 26175
MIYASAKA, T., Effects of orotic acid on radiation injuries, 16: 25257
MIZUTANI, Y., Acute U poisoning, 16: 25158
MOAT, A., Prompt neutrons from U-235 fission, 16: 26513
MOCOROA, A., Yield ratios for isomeric pair Te-121m, Te-121, 16: 26240
MOINEREAU, P., Fast power reactors, 16: 26551
MOINEREAU, P., Multi-group calculations for fast reactors, 16: 26537
MOINEREAU, P., Physical research on RAPSODIE, 16: 26569
MOISEIWITSCH, B. L., Elastic scattering of electrons, 16: 26033
MOLDAUER, P. A., Fast-neutron reaction cross sections, 16: 26517
MOLDAUER, P. A., Neutron strength function, 16: 26212
MOLINA, Roger, Chemical properties of elements in molten LiCl, 16: 25306 (CEA-2125)
MOLINARI, V. G., Influence of extraction hole on neutron spectra, 16: 26199 (NP-11932)
MONAHAN, T. I., Prog. rpt. on thermal radiation studies, 16: 25876 (AFSWP-844)
MONETI, G. C., Decay of negative hyperon, 16: 26141
MONETI, G. C., Polarization of recoil nuclei, 16: 25941 (NP-11977(p.120-1))
MONETI, G. C., Use of He bubble chamber, 16: 25925 (NP-11977(p.60-2))
MONK, C. B., Recoil effects of C-15 in toluene, 16: 25438
MONK, R. G., Methods in radiochemical analysis. II., 16: 25285
MONTARIOL, Frederic, Resistivity of massive Al samples, 16: 25775
MONTY, Kenneth J., Prog. rpt. on metabolism of Cu and Fe, 16: 25151 (TID-16073)
MOORE, G. A., Phases in Nb--Sn alloys, 16: 25791

MOORE, George E., Catalytic reactions on semiconductors, 16: 25355
MOORE, J. G., Separation of U and Th, 16: 25494
MOORE, K. V., Kinetic effects of scram rods, 16: 26468 (IDO-16777)
MOORE, R. E., Preparation of high-purity BeO, 16: 26481 (TID-7622 (p.122-7))
MOORE, S. O., Correlation of integral experiments and high-energy cross-sections, 16: 26532 (BNL-5604; BNL-5892)
MOORE, W. C., Maritime GCR land-based prototype, 16: 26592 (GAMD-1722)
MOORHEAD, T. P., Calculations for large dilute fast reactor, 16: 26542
MOREH, R., Reaction $O^{18}(t,p)O^{20}$ in a nuclear reactor, 16: 26291
MOREL, Pierre, Lifetime effects in condensed He-3, 16: 25983
MOREWITZ, H. A., Epithermal critical experiments, 16: 26525
MORGAN, L. L., Effects of radiation on elastomers and plastics, 16: 25843 (NARF-62-5T)
MORGULIS, N. D., Current oscillations in thermionic energy converter, 16: 25957 (FTD-TT-62-637)
MORI, H., Influence of Ra on ocular tissue. III., 16: 25185
MORI, H., Influence of Ra on ocular tissue. IV., 16: 25186
MORI, H., Influence of Ra on ocular tissue. V., 16: 25187
MORI, Hozimo, Theory of ferromagnetic spins, 16: 26013
MORIYA, S., Effects of radiation on nucleic acid, 16: 25208
MOROZ, V. I., Potential of a metal sphere in space, 16: 26050
MOROZUMI, S., Behavior of inclusions in Be, 16: 25784
MORRIS, E., Equation of state data for U, 16: 25376
MORRIS, P. R., Growth of large perfect crystals of α U, 16: 25329 (AEC-tr-5249)
MORRISEN, D., Ionization measurements from H_2 bubble chamber, 16: 25921 (NP-11977(p.45-48))
MORSE, D. C., Removal of radioactive Kr and Xe from flowing He stream, 16: 26489 (TID-7622(p.218-35))
MORSE, L. E., Recombination of radiolytic gases, 16: 25407
MOSS, H. I., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
MOUTURAT, Pierre, Fragility of Fe–Al solid solution, 16: 25776
MRAZ, F. R., Intestinal absorption of Sr-85 and Ca-45, 16: 25114 (HW-72500(p.15-18))
MUCKNIK, M., Photoproduction of K mesons in H_2, 16: 25947 (NP-11977 (p.137-9))
MUEHLSCHLEGEL, Bernhard, Depolarization of transversely polarized electrons, 16: 26178
MUELLER, G., Radioactivities of fluorites, 16: 25622
MUELLER, Horst, Mechanism of chemical secondary reactions, 16: 25449
MUELLER, William M., Advances in x-ray analysis. V., 16: 25298
MUELLER-BUSCHBAUM, H., Fluorescence of rare earths, 16: 25974
MU, J. Y. P., Reactions of N with $N^{15}O$ and N_2^{15}, 16: 25362
MUKAIBO, T., Heat of formation of U_3O_7, 16: 25378
MUKAIBO, T., Specific heat of U carbides, 16: 25379
MULFORD, Robert N. R., Volatility of Pu carbide, 16: 25385
MULLER, T., Magnetic moment of the muon, 16: 26115
MULLIKIN, T. W., Critical dimensions of reactors, 16: 26064 (RM-2917-PR)
MULLINS, J. H., Bubble density measurement, 16: 25883 (CTSL-33)
MUNOZ, J., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
MURTAS, G. P., Bremsstrahlung intensity from electron synchrotron, 16: 26136
MURTAS, G. P., Polarized photon beam from Frascati synchrotron, 16: 25932 (NP-11977(p.93-4))
MUSCHLITZ, E. E., Jr., Collisions of He atoms in gases, 16: 26238
MUSIALOWICZ, T., Latent image fading in film emulsions, 16: 25645 (CLOR-11)
MYATT, J., Energy transformation using thermionic emission, 16: 25971

N

NAGAHARA, Yukio, Gamma dose rates in Japan, 16: 25675
NAGAI, Hiroyuki, Center-of-mass effects in O-16, 16: 26343
NAGAYAMA, S., Uptake of radiophosphorus, 16: 25164
NAGLE, Constance M., Wind profile in lower 400 ft of atmosphere, 16: 25611 (BNL-718)
NAGLE, D. E., Paramagnetism of Fe impurities in transition metals, 16: 25999
NAGOSHI, T., Protective effect of cysteine, 16: 25258
NAHAVANDI, Amir N., Computer analysis of loss-of-coolant accident, 16: 26587 (CVNA-117(Vol.I))
NAHAVANDI, Amir N., Computer analysis of loss-of-coolant accident, 16: 26588 (CVNA-117(Vol.II))
NAITO, K., Heat of formation of U_3O_7, 16: 25378
NAITO, K., Specific heat of U carbides, 16: 25379
NAKAJIMA, Sadao, Effect of Coulomb interaction on skin effect, 16: 26017
NAKAMURA, S., Study on Th_2O colloid uptake, 16: 25162
NAKATA, M. M., Prog. rpt. on thermal properties of refractories, 16: 25837 (AD-270841)
NAKATANI, Hiroshi, Sintered Be powder, 16: 25780
NAKATANI, Hiroshi, System of interacting Bose particles. I., 16: 26162
NAKATANI, Hiroshi, System of interacting Bose particles. II., 16: 26163
NAKATANI, R. E., Distribution and retention of Sr^{90}–Y^{90} in trout, 16: 25117 (HW-72500(p.26-9))
NAKATANI, R. E., Reactor effluent monitoring with salmon, 1960-1961, 16: 25143 (HW-72500(p.144-7))
NAMETKIN, N. S., Radiation polymerization and copolymerization of allyl-hydrosilanes, 16: 25459
NARIAI, Hidekazu, Invariant spatial distance in curved space-time, 16: 26011
NARIAI, Hidekazu, Spatial distance in a curved space-time. II., 16: 26016
NASH, W. F., Cosmic μ-meson spectra, 16: 26055
NASSIFF, S. J., Yield ratios for isomeric pair Te-121m, Te-121, 16: 26240
NASTYUKHA, A. I., Mass-spectrometer for investigating ion sources, 16: 26390 (FTD-TT-61-242(p.162-6))
NATHAN, M. E., Delta-phase isothermal hydriding of U–Zr, 16: 25756 (NAA-SR-6264)
NAZARCHUK, T. M., Analysis of high-melting alloys, 16: 25835
NAZAREWICZ, W., Phonon absorption bands in fast-neutron-irradiated Si, 16: 25866
NEAMU, I., Angular correlations in $S^{34}(p,p'\gamma)$, 16: 26327
NEAMU, I., Scattering of low energy protons on S-32, 16: 26352
NEDELIK, A., Research reactor Astra, 16: 26623
NEDYALKOV, I. P., Edge problem in dispersion ration, 16: 26077 (JINR-P-949)
NEIL, J., Decontamination of buildings, 16: 25498 (AECL-1531)
NEILER, J. H., Neutron capture cross sections, 16: 26509
NEITZEL, W. E., Airborne contamination control, 16: 25509 (TID-16274)
NEKRASOV, P. S., Solar cell array optimization, 16: 25080 (ASD-TR-61-11(Vol.I))
NELSON, David L., Stripping film in autoradiography, 16: 25508 (TID-16158)
NELSON, E. S., Radiation-induced myeloid leukemias of RF mouse, 16: 25199
NELSON, R. W., Hanford ground water flow, 16: 25613 (HW-73711)
NEMETS, O. F., Proton spectra in stripping reactions, 16: 26356
NESBET, R. K., Theory of superconductivity. I., 16: 25987
NESMEYANOV, An. N., Vapor pressure of Sc, 16: 25778
NESMEYANOVA, A. N., Vapor pressure of metallic Y, 16: 25405
NESTEROV, V. P., Cesium and Sr in human organs, 16: 25157
NESTOR, C. W., Jr., Program for analysis of kinetics of MSRE, 16: 26619 (ORNL-TM-203(Add.))
NETA, P., Chemical behavior of F-18, 16: 25432
NEUGEBAUER, F. J., Condenser analysis, 16: 25540 (AD-269401)
NEUGEBAUER, F. J., Power control of double-acting "steamotor", 16: 25539 (AD-269391)
NEVSKAYA, N. M., Nutation in experiments on nuclear magnetic resonance, 16: 25965 (JPRS-13656(p.260-78))
NEVZGLYADOV, V. G., Turbulent flow in circular tubes, 16: 25529 (AEC-tr-5214)
NEWELL, D. M., Effects of radiation on elastomers and plastics, 16: 25843 (NARF-62-5T)
NICHOLLS, R. W., Allowed transitions, 16: 26026
NICHOLS, J. P., Neutron poisons as criticality control, 16: 25415 (ORNL-3309)
NICKLAS, John H., Fuel-breeder fuel element, 16: 26580
NICOLAU, F. Medina, Schematic theory of nuclear reactions, 16: 26345
NICOLL, D., Analysis of radial arm indexing mechanism. Top transfer machine, 16: 26465 (GAMD-1318)
NICONIENKO, S., Solar cell array optimization, 16: 25080 (ASD-TR-61-

11(Vol.I))
NIGRO, M., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
NIGRO, M., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37 (p.76-80))
NIGRO, N., Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
NIKITIN, A. V., Properties of π^- mesons, 16: 26081 (JINR-P-974)
NIKITIN, S. Ya., Elastic scattering of 7.2-Bev π^- mesons on protons, 16: 26180
NIKITIN, Yu. P., Diffraction formation of particles at high energies, 16: 26089 (NP-11832)
NIKOLAEV, N. S., Chemistry and production of U fluoride compounds, 16: 25470
NILSSON, S. G., Giant E1 resonance for deformed nuclei, 16: 26253 (UCRL-9803)
NISHIHARA, Hiroshi, Stability of boiling HWR, 16: 26601 (AEC-tr-5078)
NISHIHARA, Hideaki, Stability of boiling HWR, 16: 26601 (AEC-tr-5078)
NOBLE, Charles E., Jr., High-temperature transport coefficients of gases, 16: 25880 (ARL-62-328)
NOE', E. S., Growth of large perfect crystals of α U, 16: 25329 (AEC-tr-5249)
NORDAU, Claudy-Gabrielle, The bee and radioactivity, 16: 25203
NORELIUS, Charles Edward, Scintillation crystals for neutron dosimetry, 16: 25570 (TID-16107)
NORTH, A. A., Extraction of U from ores, 16: 25468 (NCL/AE-197)
NOVICK, M., Stability of EBR-I, 16: 26558
NOVICK, R., Hyperfine structure of atomic N, 16: 26318
NOVIKOV, M. T., Electron capture by He ions, 16: 26021
NOYAN, Ahmet, Water absorption from intestine to lymph and blood, 16: 25130 (HW-72500(p.84-7))
NOZIERES, Philippe, Lifetime effects in condensed He-3, 16: 25983
NOZIK, Yu. Z., Small neutron diffractometer, 16: 25593
NUTTAL, R. L., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396

O

OBERHAUSEN, Erich, Prog. rpt. on biological aspects of radiation, 16: 25167 (NP-11884)
OBERSKI, J. E. J., Excited states of Ag-107, 16: 26280
O'BRIEN, John L., Fracture of metals, 16: 25759 (NP-11890)
O'BRIEN, R. T., Effects of D_2O on yeast, 16: 25137 (HW-72500(p.113-18))
O'BRIEN, R. T., Uptake and distribution of thymidine by yeast, 16: 25136 (HW-72500(p.109-12))
OBUKHOV, A. I., Light fragmentation products and fission at high energies, 16: 26329
ODA, M., Particles generated by a supernova, 16: 26048
ODIAN, A., Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37 (p.105-9))
ODIAN, A., Photoproduction of μ-meson couples on nuclei, 16: 25931 (NP-11977(p.90-2))
ODIAN, George, Prog. rpt. on radiation-induced gelation, 16: 25418 (RAI-306)
ODING, I. A., Effect of radiation on heat strength of steel, 16: 25859
OEPIK, E. J., The lunar atmosphere, 16: 26049
OEPIK, U., Photoionization processes, 16: 26027
OGARD, A. E., Preparation of UC–PuC solid solutions, 16: 25706
OGBORN, R. E., Radioisotope accountability system, 16: 25663
OGDEN, H. R., Effect of Zr on Ti–Al, 16: 25820
OGDEN, J. W., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
OGIEVETSKII, V. I., Properties of $K^0\bar{K}^0$ meson pairs, 16: 26078 (JINR-P-960)
OGIEVETSKII, V. I., Quantum electrodynamics in terms of electromagnetic field strengths, 16: 26433 (JINR-E-975)
OGILVIE, Keith W., Solar protons, 16: 26052 (NASA-TN-D-1139)
OGILVIE, R. E., Identification of stratospheric aerosols, 16: 25609 (AFCRL-62-299)
OGLE, P. R., Hexafluorides of Mo, W, and U. I., 16: 25339 (GAT-T-969)
OHLINGER, Lee A., Neutronic reactor manipulating device, 16: 26575
OHLSEN, W. D., Paramagnetic relaxation of color centers in KCl, 16: 25985
OHNO, Yoshihisa, JAERI neutron crystal spectrometer, 16: 25557 (JAERI-1030)
OHNUMA, Y., Mast cells of rats after irradiation, 16: 25206
OKA, H., Pulmonary radiation fibrosis, 16: 25165
OKAMOTO, Koichi, JAERI neutron crystal spectrometer, 16: 25557 (JAERI-1030)
OKANO, Masaharu, Gamma dose rates in Japan, 16: 25675
O'KELLEY, G. D., Nuclear levels of Ge-74, 16: 26283
O'KELLY, L. B., Quasi-trapping of electrons in water vapor, 16: 25973
OKONOV, E. O., Magnetic moment of K^0 meson, 16: 26182
OKONOV, E. O., Properties of $K^0\bar{K}^0$ meson pairs, 16: 26078 (JINR-P-960)
OKRENT, D., Nuclear aspects of fast-reactor safety, 16: 26563
OKRENT, D., Performance of large fast power reactors, 16: 26550
OKRENT, D., Safety programme in Treat, 16: 26564
OKUN, L. B., New particles and Sakata model, 16: 26187
OLSEN, S., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
OLSON, P. A., Incidence and virulence of columnaris, 16: 25145 (HW-72500(p.151-5))
OLSON, P. A., Reactor effluent monitoring with salmon, 1960-1961, 16: 25143 (HW-72500(p.144-7))
OMHOLT, A., Velocities of auroral rays, 16: 26060
ONISHCHENKO, L. N., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
ONKELINX, CL, Effects of x irradiation on heart of frog, 16: 25216
ONSTEAD, Charles O., Prog. rpt. on biological aspects of radiation, 16: 25167 (NP-11884)
OPHEL, T. R., Proton bombardment of B-10, 16: 26248
OPPLIGER, L., Proton-oxygen differential scattering cross sections. II., 16: 26323
ORATOVSKII, Yu. A., Obtaining intense beam of polarized thermal neutrons, 16: 26198 (NP-11859)
ORBACH, R., Spin-lattice relaxation in multilevel spin systems, 16: 25995
ORMROD, J. H., Mass differences between Sa isotopes, 16: 26335
ORR, William Harold, Oxide nucleation and growth, 16: 25716 (NP-11876)
ORSENIGO, M., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
ORTNER, J., Kiruna observations of Novaja Zemlja tests, 1961, 16: 25086 (KGO-611)
OSBORNE, D. V., Liquid-vapor equilibrium in He II, 16: 26006
OSBORNE, Darrell W., Thermodynamic properties of ZrH_2, ZrD_2, YH_2, and YD_2, 16: 25395
OSGOOD, Edwin E., Observations on human hemic cells, 16: 25191
OSIPOV, Yu. A., Conditions of super-high frequency EM field irradiation, 16: 25662 (JPRS-13691(p.20-4))
OSTER, Ludwig, Radiation laws, 16: 25879 (ARL-62-320)
OTOMO, S., Thermal neutron absorption and scattering cross sections, 16: 26194 (JAERI-6010)
OTSUKA, Hideko, Gamma dose rates in Japan, 16: 25675
OTT, K., Behavior of fast breeders, 16: 26546
OTTE, H. M., Dilation parameters in martensitic transformation, 16: 25763 (TID-16191)
OTTERSTROM, K., Determining sand movement by labeled sand, 16: 25641
OVADIA, J., Production and properties of high-energy electrons, 16: 25188
OVERHOLSER, L. G., Evolution of gas from graphites, 16: 26474 (TID-7622(p.24-34))
OWENS, C. W., Chemical state of Cl-36, 16: 25443
OXLEY, J. H., Ceramic-coated nuclear-fuel particles, 16: 26476 (TID-7622 (p.57-73))
OYAMA, Yoshitoshi, Separation of isotopes by nozzle process, 16: 25687 (AEC-tr-5069)

P

PAIS, A., Decays of G eigenstates, 16: 26148
PAL, M. K., Collective quadrupole state of C-12, 16: 26278
PALENZONA, D. L., Irradiation of seeds in tomatoes, 16: 25197 (CNEN-119)
PALMA, L. Dalla, Intestinal absorption of I^{131}-labeled triolein, 16: 25230
PALMER, George M., Efficiency of rail accelerators, 16: 26367 (AFOSR-1631)
PALUSZKIEWICZ, S., Analysis of Spert-III critical experiments, 16: 26456 (APAE-MEMO-279)

PANDYA, S. P., Binding energy of hypernuclei. L, 16: 26344
PANNELL, J. H., Elution of U from anion exchange resins, 16: 25463 (ACCO-12)
PAOLUZI, L., Photoproduction of π^+, 16: 25891 (LNF-62/37(p.34-9))
PAOLUZI, L., Photoproduction of pions in H_2 and D_2, 16: 25943 (NP-11977(p.124-6))
PAPPAS, A. C., Radiochemical studies of isotopes of Sb and Sn, 16: 25442
PAPROCKI, Stan J., Fuel from alumina-coated UO_2 particles, 16: 25749 (BMI-1586)
PARDUE, William M., Fuel from alumina-coated UO_2 particles, 16: 25749 (BMI-1586)
PARIS, Gyula, Extraction system of ion sources, 16: 25577 (NP-tr-902)
PARK, J. F., Changes following inhalation of $Pu^{239}O_2$, 16: 25126 (HW-72500(p.67-73))
PARK, J. J., Phases in Nb–Sn alloys, 16: 25791
PARKER, G. W., Fission products from reactor-grade UO_2, 16: 26484 (TID-7622(p.149-59))
PARKER, H. S., Susceptor elements for high-temperature induction heating, 16: 25704
PARKER, K., Punched-card library of neutron cross sections, 16: 26520
PARKINSON, W. C., Prog. rpt. on 83-inch cyclotron, 16: 26375 (TID-16329)
PARKS, R. D., Transition temperature of a superconducting cylinder, 16: 25998
PARR, J. Gordon, Nonnuclear uses for U, 16: 25707
PARSONS, D. F., Radiation-induced myeloid leukemias of RF mouse, 16: 25199
PASQUET, R., Neutron-flux propagation in fast reactors, 16: 26531
PATEL, P. M., Measurement of the triple scattering parameter, 16: 26140
PATNRIA, R. K., Mechanics of a many-body system, 16: 26168
PATRICK, Jack W., Leptonic Σ^+ decay, 16: 26143
PAUL, Armine D., Complexing of Sc(III) and Y(III), 16: 25356
PAULEVE, J., Apparatus for irradiating in swimming pool reactor, 16: 26615 (CEA-2134)
PAVLIKOVSKII, A., Theory of even-even non-spherical nuclei, 16: 26218 (JINR-P-923)
PAVLOV, V. S., Vapor pressure of U compounds, 16: 25371
PAYNE, George O., Jr., Packaging for radiation pasteurized foods, 16: 25681 (TID-15144)
PEDRINI, A., Neutron flux distribution gage, 16: 25562 (NP-11705)
PEIERLS, R. F., Pion-nucleon coupling constant, 16: 26105
PELLEGRINI, C., Electron oscillations in circular accelerator, 16: 26393
PELLEGRINI, F., Reaction $Al^{27}(d,He^3)Mg^{25}$, 16: 26313
PENSLER, J. P., Prog. rpt. on solubility of gases in Be, 16: 25757 (NMI-9815)
PENDLEBURY, E. D., Changes in U-235 and U-238 neutron-scattering data, 16: 26541
PENDLEBURY, E. D., Critical size and reactivity calculations, 16: 26539
PENEV, V. N., Production of ΛK^0 and $K^0\bar{K}^0$ pairs in $\pi^- p$ interactions, 16: 26068 (JINR-D-965)
PENNEMAN, Robert A., Concerning Na_3UF_8, 16: 25328 (AEC-tr-5205)
PENTELKOV, V. G., Correlation of granite intrusives, 16: 25630
PEPIN, P., Neutron-flux propagation in fast reactors, 16: 26531
PEPIN, Pierrette, Fragility of Fe–Al solid solution, 16: 25776
PEPKOWITZ, L. P., Coatings for UO_2 and U particles, 16: 26479 (TID-7622(p.98-107))
PERCHEREAU, Janine, Scattering of neutrons by C, 16: 26288
PERCUS, J. K., Methods in classical statistical mechanics, 16: 26445
PERELYGIN, V. P., Recording of nuclear fission fragments, 16: 25558 (JINR-P-979)
PEREY, F., Nuclear collective motions, 16: 26334
PERFILOV, N. A., Light fragmentation products and fission at high energies, 16: 26329
PERKINS, J. F., Design of ARGMA 8,000-kw plasma facility, 16: 25499 (ARGMA-TN-2H5N)
PERONE, S. P., Determination of I with Ag microelectrodes, 16: 25279
PERRY, K. E. G., Emergency air sampling, 16: 25542 (AEEW-R-150)
PETERLONGO, G., Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
PETERS, C. W., Infrared absorption spectrum of CD_4, 16: 25345
PETERSEN, J., Environmental radioactivity in Denmark, 1961, 16: 25169 (RISÖ-41)
PETIT, Jean, Fragility of Fe–Al solid solution, 16: 25776
PETRASHKU, M. G., Anomalies in μ^- meson decay in paramagnetic metals, 16: 26080 (JINR-P-972)
PETROV, V. A., Enthalpy of W, 16: 25779
PETROV, Yu. N., Formation of ω phase in Ti alloys, 16: 25830
PETRUKHIN, V. I., Charge exchange of π^- mesons stopped in H_2, 16: 26190
PETRZHAK, K. A., Kinetic energy of fragments emitted in fission of U-238, 16: 26355
PETSCHEK, H. E., Deviation of MAST operation, 16: 25912 (NP-11848)
PETTI, L. J., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
PETTY, Robert, Prog. rpt. on movement of Rb-86 and P-32 in forest, 16: 25150 (TID-15963)
PETUNIN, B. V., Thermal power engineering for nuclear installations, 16: 26605 (FTD-TT-61-241)
PETUSHKOV, A. A., Circular polarization of γ quanta, 16: 26292
PHAM-DINH-LIEN, Reaction $C^{13}(Li^6,\alpha)N^{15}$, 16: 26249
PHILLIPS, G. O., Radiation chemistry of carbohydrates. IX., 16: 25439
PHILLIPS, G. O., Radiation chemistry of carbohydrates. X., 16: 25440
PHILLIPS, John D., Computer analysis of loss-of-coolant accident, 16: 26587 (CVNA-117(Vol.I))
PHILLIPS, John D., Computer analysis of loss-of-coolant accident, 16: 26588 (CVNA-117(Vol.II))
PHILLIPS, H. J., Initial stages of pinch discharge, 16: 26421
PHILLIPS, V. A., Dispersion hardening, 16: 25693 (ARL-62-357)
PHIPPS, T. E., Theory of periodic deviations in Schottky effect, 16: 25954 (TID-16225)
PIANTANIDA, Ermisio, Behavior of explosives under γ irradiation, 16: 25858
PIAZZI, Marcello, Behavior of explosives under γ irradiation, 16: 25858
PIAZZOLI, A., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
PIAZZOLI, A., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
PICASSO, E., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
PICKETT, Andrew G., Sea disposal containers, 16: 26641 (TID-15431)
PICKWICK, Fred J., Jr., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
PICTON, James Simon, Shock absorbers, 16: 26572
PIEKOSZEWSKI, Jerzy, Properties of Ge bombarded with neutrons, 16: 25851 (PAN-316/I-B)
PIERAGOSTINI, F., Facilities of Avogadro RSI reactor, 16: 26625
PIERSON, T. M., Gas cooled reactor study, 16: 26497 (TID-16138)
PIESZKOWA, W. M., Investigations of complex compounds in solutions, 16: 25368
PIETSCHMANN, H., High-energy elastic scattering, 16: 26122
PIKAEV, A. K., Radiolysis of Rh compounds, 16: 25430
PILET, P.-E., Radiation effect on biological systems. III., 16: 25254
PILIPENKA, A. T., Analysis of high-melting alloys, 16: 25835
PILKINGTON, F. B., Crosslinking of polyethylene and paraffins by uv, 16: 25455
PIMBLEY, George H., Newton's polygon and role in present mathematics, 16: 25692 (AEC-tr-5139)
PINCHERA, G. C., Critical heat flux in pool boiling, 16: 25525 (NAA-SR-Memo-6928)
PINTO, L., Determination of Zr in Th–Zr alloys, 16: 25284
PIONTKOVSKII, I. A., Function and structure of nervous system exposed to radiation, 16: 25237
PIONTKOVSKOGO, I. A., Effects of radiation on nervous system of progeny, 16: 25236
PIPER, H. B., Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
PIRAGINO, G., Activity of the bubble and diffusion chamber group, 16: 25945 (NP-11977(p.129-35))
PIRAGINO, G., Photodisintegration and photoproduction of π mesons, 16: 25888 (LNF-62/37(p.10-13))
PIVOVAR, L. I., Electron capture by He ions, 16: 26021
PLATZER, R., Fixing of phosphoric ions by Zr–montmorillonite, 16: 25305 (CEA-1650)
PLISKO, E. A., Interaction of uranyl salts with chitin, 16: 25487
POCS, L., Circular polarization of γ quanta, 16: 26267
PODGORETSKII, M. I., Properties of $K^0\bar{K}^0$ meson pairs, 16: 26078

(JINR-P-960)
PODOLSKAYA, N. S., Heat of formation of compounds of Pu with Al and Fe and of U with Fe, 16: 25834
POHL, R. O., Phonon resonance scattering, 16: 25996
POHLMAN, Jack R., Sea disposal containers, 16: 26641 (TID-15431)
POKROVSKII, V. N., Reaction $Al^{26}(p,p\pi^+)Mg^{25}$, 16: 26354
POLAK, L. S., Radiation polymerization and copolymerization of allylhydrosilanes, 16: 25459
POLANYI, J. C., Chemical processes, 16: 26045
POLLARD, D. D., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
POLUBARINOV, I. V., Quantum electrodynamics in terms of electromagnetic field strengths, 16: 26433 (JINR-E-975)
POMERANCHUK, I. Ya., Amplitudes of meson-nucleon and nucleon-nucleon scattering, 16: 26191
POMORSKII, L., Transfer of neutrons in Al, Cu, and Ta bombardment, 16: 26221 (JINR-P-973)
PONOSOV, A. K., Elastic π^- meson scattering on C, 16: 26365
PONTZEN, Theodore C., Insurance against nuclear risks, 16: 25666
POOL, R. A. H., Impurities in liquid metal coolant and their effect on Nb and V, 16: 26475 (TID-7622(p.35-56))
POPOV, M. A., Determination of V, 16: 25276 (AEC-tr-5250)
POPOV, V. S., Analytic properties of nonrelativistic diagrams, 16: 26186
POPOV, Yu. A., Polarizable properties of electrons of μ^2 meson disintegration, 16: 26177
POREBSKI, Jan, Pulse integrators for radiation tests, 16: 25591
PORTER, E. S., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
PORTER, William S., Elastic deuteron scattering, 16: 26342
POSS, Howard L., Ultrasonic temperature determinations in plasma, 16: 26404 (RAD-TR-61-13)
POSTMUS, Clarence, Jr., Isolation of I without carrier, 16: 25264 (ANL-6577)
POULSEN, N. O. Roy, Recoil ions from α reactions, 16: 26243
POWDERLY, J. E., Purification of CdS crystals, 16: 25878 (ARL-62-319)
POWELL, J. E., Rare earth chelates of EDTA, 16: 25337 (IS-297)
POWELL, J. E., Separation of Li isotopes, 16: 25689 (IS-278)
POZZI, L. V., X-ray induction of dominant lethals, 16: 25192 (CNEN-121)
PRAKASH, Y., Decay of a He hypernucleus, 16: 26307
PRASAD, A. N., Attachment and ionization coefficients, 16: 26030
PRAVDIC, V., Proton conductivity in $Li_2SO_4 \cdot H_2O$, 16: 25333
PREDAZZI, E., High-energy limit of scattering amplitudes, 16: 26446
PRESLEY, Norman L., Scintillation scanning of the liver. II., 16: 25099
PRESSMAN, Maurice, Prog. rpt. on SM-1 environmental radiological monitoring, 16: 25646 (ERDL-1691-TR)
PRICE, Michael Stuart Thomas, Manufacturing C articles, 16: 25743
PRIGOGINE, I., Some aspects of irreversible thermodynamics, 16: 25382
PRISELKOV, Yu. A., Vapor pressure of Sc, 16: 25778
PRISOLKOVA, Y. A., Vapor pressure of metallic Y, 16: 25405
PRITCHARD, W. C., Preparation of UC–PuC solid solutions, 16: 25706
PROKOSHKIN, Yu. D., Angular distribution of π mesons, 16: 26082 (JINR-P-981)
PROKOSHKIN, Yu. D., Charge exchange of π^- mesons stopped in H_2, 16: 26190
PROSPERI, G. M., Quantum theory of measurement, 16: 26439
PROTASOV, V. P., Elastic π^- meson scattering on C, 16: 26365
PROVOW, Douglas M., Electrical resistivity of Th–Mg eutectic, 16: 25754 (IS-437)
PRUETT, Paul B., Prog. rpt. on SM-1 environmental radiological monitoring, 16: 25646 (ERDL-1691-TR)
PSHEZHETSKII, V. S., X-ray-induced polymerization of acetaldehyde, 16: 25461
PUGLISI, M., Elements of plan of 10-Bev electron synchrotron, 16: 25929 (NP-11977(p.78-80))
PULLEN, D. J., Analysis of stripping optical model parameters, 16: 26300
PUMMERY, F. C. W., Cesium separation. III., 16: 25472 (AERE-R-4039)
PURCHAS, J. G., Direct conversion of fission heat to electric power, 16: 25972
PUROHIT, S. N., Scattering of thermal neutrons, 16: 26209 (BNL-5821)

Q

QUAN, J. T., Vapor pressures in $Rb_2O–B_2O_3$, 16: 25325 (USNRDL-TR-566)
QUANDT, E. R., Basic parameters in two phase annular flow, 16: 25528 (WAPD-T-1502)
QUARENI, G., Decay of positive K mesons, 16: 25920 (NP-11977(p.40-4))
QUARRELL, A. G., Niobium, Ta, Mo, and W, 16: 25708
QUASSIATI, I., Photoproduction of K mesons in H_2, 16: 25947 (NP-11977 (p.137-9))
QUERZOLI, R., Cross section of the process $\gamma + p \rightarrow \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
QUERZOLI, R., Polarization of recoil protons, 16: 25939 (NP-11977(p.111-15))
QUERZOLI, R., Scintillation chambers, 16: 25940 (NP-11977(p.116-20))
QUERZOLI, R., Study on the process $\gamma + p \rightarrow \eta + p$, 16: 25897 (LNF-62/37 (p.89-98))
QUITTNER, G., Research reactor Astra, 16: 26623

R

RADHA, T. K., On Y* resonances, 16: 26111
RAE, D. M., Silicon nitride as high-temperature material, 16: 25795
RAFALOVSKII, V. A., Formation of ω phase in Ti alloys, 16: 25830
RAFIKOV, S. R., Radiation polymerization of vinyl monomer on fiber, 16: 25431
RAGENT, Boris, High-temperature transport coefficients of gases, 16: 25880 (ARL-62-328)
RAGENT, Boris, Thermodynamic properties of gases, 16: 25300 (ARL-62-358)
RAGO, A., Resonance scattering in light elements, 16: 26521
RAGONE, D. V., Thermodynamics of U–Bi system, 16: 25387
RAINEY, R. H., Separation of U and Th, 16: 25494
RAINWATER, J., Mu mesonic atom studies of Ti, Fe, Cu, Zn, Tl, Pb, and Bi, 16: 25909 (NEVIS-105)
RAJAGOPAL, A. K., Scattering of thermal neutrons, 16: 26209 (BNL-5821)
RAMAKRISHNAN, Alladi, Partial wave dispersion relations for A-N scattering, 16: 26110
RAMAKRISHNAN, Allari, On Y* resonances, 16: 26111
RAMASWAMY, M. K., Fluorescence yield in Tl, 16: 26257
RANDOLPH, M. H., Determination of C in UF_4, 16: 25283 (TID-12773)
RANE, A. T., Preparation of Tb-161, 16: 25445
RANGE, W. H., Pion-nucleon coupling constant, 16: 26105
RAO, B. N. Subba, Nuclear studies with Gd-159, 16: 26293
RAO, M. Narayana, Correlation measurements in Xe-132, 16: 26246
RAPPENEAU, J., Stored energy in irradiated graphite, 16: 25864
RAPPERPORT, E. J., Prog. rpt. on solubility of gases in Be, 16: 25757 (NMI-9815)
RASOR, N. S., Thermionic converters, 16: 26598 (NAA-SR-7144)
RASTIN, B. C., Cosmic μ-meson spectra, 16: 26055
RASTOIN, J., Neutron-flux propagation in fast reactors, 16: 26531
RAU, R. R., Decay of negative hyperon, 16: 26141
RAUH, E. G., Vaporization studies of UC_2 phase, 16: 25393
RAUH, E. G., Vaporization and thermodynamic properties of US and UOS, 16: 25399
RAYKHRUDEL', E. M., Multi-beam high-vacuum gas discharge pump, 16: 25511 (FTD-TT-62-370)
REALE, A., Photoproduction of neutral mesons, 16: 25898 (LNF-62/37 (p.98-104))
REALE, A., Photoproduction of π^0 mesons from H_2, 16: 25936 (NP-11977 (p.102-4))
REAVIS, James G., Method for obtaining Pu metal, 16: 25711
RECHTER, H. L., Materials for resistance strain gages, 16: 25560 (NAVORD-ASL-1050(Pt.III))
RECKE, W., Radioactivities of fluorites, 16: 25622
REDEI, L. B., Stark effect in the H atom, 16: 25980
REED, R. I., Ion production by electron impact, 16: 26022
REED, T. B., Superconducting Nb_3In, 16: 25803
REGGE, T., High-energy limit of scattering amplitudes, 16: 26446
REICH, Robert, Resistivity of massive Al samples, 16: 25775
REID, D. L., Fission product release from U, 16: 25841 (HW-72321)

REINES, F., Experimental test of conservation of nucleus, 16: 26328
REISS, Howard, Statistical thermodynamics of fused salts, 16: 25390
REITER, Reinhold, Relative air radioactivity, 16: 25625
REMY, J., Biological study of luminous paint, 16: 25110 (CEA-2155)
RIBON, P., Measuring cross sections in fast reactors, 16: 26506
RICE, G., Direct conversion of fission heat to electric power, 16: 25972
RICE, P. A., Thermodynamics of U–Bi system, 16: 25387
RICE, Stuart A., Mobility of ions in liquid He^4I and He-3, 16: 25984
RICHARD, Jacques, Isotopic effect during reaction of cuprous oxide, 16: 25410 (CEA-2120)
RICHARDS, H. T., Fluorine-17 level parameters, 16: 26324
RICHARDSON, D. M., Summary of HRT Run 25, 16: 26618 (ORNL-TM-173)
RICHMOND, W. J., Prog. rpt. on power reactors, 16: 25735 (NMI-7251)
RICHTER, Harold G., Thallium-204 determination of dissolved O_2 in water, 16: 25282
RICKARD, W. H., Jr., Harvest yields in natural plant communities, 16: 25147 (HW-72500(p.159-60))
RICKARD, W. H., Jr., Producers and decomposers in a desert soil, 16: 25148 (HW-72500(p.161-4))
RICKARD, W. H., Jr., Radionuclides in Arctic plants and animals, 16: 25149 (HW-72500(p.165-9))
RICKARDS, G. A., Creep cavities in Mg alloys, 16: 25790
RIEKE, Foster F., Prog. rpt. on applications of isotopes, 16: 25271 (TID-16156)
RIESE, Gretchen R., Concerning Na_3UF_8, 16: 25328 (AEC-tr-5205)
RINGSTROEM, Ulf, Emission spectrum of AgD, 16: 25331
RIPPON, Simon Edward, Apparatus for detecting radioactivity in fluid, 16: 25596
RIPPON, Simon Edward, Apparatus for detecting radioactivity in fluid, 16: 25598
RISPOLI, B., Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
RISPOLI, B., Measurement of mean life of π mesons, 16: 25901 (LNF-62/37(p.118-38))
RITCHIE, R. H., Optical emission from irradiated metallic foils, 16: 25847 (ORNL-3114)
RITCHIE, R. H., Optical emission from irradiated foils. I., 16: 26314
RITTER, M., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
RITTER, Rogers Charles, Coulomb excitation with heavy ions, 16: 26230 (TID-16058)
RIVIERE, J. C., Work function of U, 16: 25808 (AERE-R-3819)
RIVIERE, J. C., Work function of Th, 16: 25809 (AERE-R-3910)
ROBERTS, D. L., Pulse fission counters, 16: 25541 (AEEW-R-107)
ROBERTS, J., Fission properties utilized in reactor design, 16: 26512
ROBERTS, L. E. J., Thermodynamic data for U oxides, 16: 25377
ROBERTS, R., Radiation effects in peppermint oil, 16: 25450
ROBERTSON, J. A. L., Properties of ceramic fuels, 16: 25745 (AECL-1529)
ROBINSON, J. R., Neutron activation of P, 16: 25289
ROBINSON, L. B., Growth and analysis of Al_2O_3 "whiskers," 16: 25694 (ASD-TDR-62-272)
ROBINSON, R. L., Nuclear levels of Ge-74, 16: 26283
ROCHER, Y. A., Crystal structure of rare earths, 16: 25801
RODBELL, D. S., Spontaneous magnetization in solid bodies, 16: 25882 (ASD-TR-61-630)
RODERICK, Thomas H., Prog. rpt. on population genetics of irradiated mice, 16: 25182 (TID-16323)
RODERIQUE, J. S., Purification of CdS crystals, 16: 25878 (ARL-62-319)
ROE, Byron P., Form factors in K_{e3} and $K_{\mu 3}$ decay, 16: 26135
ROGINSKII (ROGINSKIY), S. Z., Isotopes in catalysis, 16: 25261 (JPRS-13785)
ROGOZINA, E. M., Interaction of uranyl salts with chitin, 16: 25487
ROHOZINSKI, Grzegorz, Optical model potential, 16: 26229 (PAN-304/VII)
ROMANOVSKII, E. A., Proton absorption by Cu-63, 16: 26349
ROMMEL, H., Purity testing of rare earths, 16: 25292
RONDEAU, Roger E., Radiation chemistry of pentane isomers, 16: 25421 (WADD-TR-61-38)
ROSEN, L., Elastic scattering of polarized protons by C-12, 16: 26263
ROSEN, Nathan, Investigations on fields, 16: 26066 (ARL-62-332)
ROSENBERG, P. E., Coprecipitation of metallic ions with Ca carbonate, 16: 25319 (TID-16128)
ROSENBLATT, J., Magnetic deflector system of synchrocyclotron beam, 16: 26373 (NP-11693)
ROSENBLATT, J., Magnetic deflector of synchrocyclotron beam, 16: 26374 (NP-11889)
ROSNER, B., First excited 0^+ state in O-16, 16: 26298
ROSS, A. E., Impurities in liquid metal coolant and their effect on Nb and V, 16: 26475 (TID-7622(p.35-56))
ROSS, A. M., Heat transfer coefficient between UO_2 and Zy-2, 16: 25523 (CRFD-1075)
ROSS, John S., Isotope shift in spectrum of Os, 16: 26317
ROSSETTI, C., High-energy limit of scattering amplitudes, 16: 26446
ROTH, W. L., Spontaneous magnetization in solid bodies, 16: 25882 (ASD-TR-61-630)
ROUX, E., Detection of β-indolylacetic acid in plant cells, 16: 25103
ROWLAND, F. S., Chemical state of Cl-36, 16: 25443
ROY, Rustrum, Family of rare earth compounds, 16: 25342
ROZENBERG, J., Dissolved gases in water of swimming pool reactor, 16: 26495 (TID-7622(p.310-15))
RUBBIA, C., Polarization of neutrons, 16: 25922 (NP-11977(p.49-52))
RUBBIA, C., Radiative capture of μ mesons, 16: 25923 (NP-11977(p.53-4))
RUBINOWICZ, A., Quadrupole radiation, 16: 26234 (NP-tr-885)
RUCKENSTEIN, E., Nucleate boiling heat transfer from horizontal surface, 16: 25531
RUDAKOV, V. A., Free-electron density in the ionosphere, 16: 26001
RUDIN, Morton, Thermodynamic properties of gases, 16: 25300 (ARL-62-358)
RUDY, E., Thermodynamics of high-melting U and Th compounds, 16: 25833
RUDZITIS, E., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
RUEDL, E., Dislocations and fission damage in Pt, 16: 25863
RUEDL, E., Vaporization of impurities in Cu, 16: 25491
RUEDORFF, Walter, Concerning Na_3UF_8, 16: 25328 (AEC-tr-5205)
RUETMAN, Sven H., Prog. rpt. on high-temperature adhesives, 16: 25699 (NP-11815)
RUFER, Richard P., Avalanche transistor switching, 16: 25581 (UCRL-6012-T(Rev.1))
RUGGE, Hugo R., Scattering of π^- on protons, 16: 26093 (UCRL-10252)
RUNDLE, R. E., Crystal structure of bis(m-bromobenzoyl) methane, 16: 25262 (IS-295)
RUSSELL, R. B., Texture in hot-extruded BeO, 16: 25789
RYAN, James, Reactions of π^- mesons, 16: 26232 (UCRL-9884)
RYAZIN, P. A., Electron acceleration capture in betatrons and synchrotrons, 16: 26384 (FTD-TT-61-242(p.54-110))
RYBAKOV, V. N., Reaction $Al^{26}(p,p\pi^+)Mg^{26}$, 16: 26354
RYBAKOV, Yu. P., Relativistic electron motion in magnetic field, 16: 26394
RYBALKO, V. S., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
RYBARSKA, V., Theory of even-even non-spherical nuclei, 16: 26218 (JINR-P-923)
RYKALIN, V. I., Charge exchange of π^- mesons stopped in H_2, 16: 26190

S

SABRY, Aluf, Functions for the electron propagator, 16: 26100
SACHS, R. G., Behavior of nucleon EM form factors, 16: 26133
SADEGHI, A., Reaction $Li^7(p,\alpha)\alpha$, 16: 26262
SADOWSKI, Marek, Magnetic fields for plasma research, 16: 26403 (PAN-301/XVIII)
SADYKHOV, F. S., Nuclear charge in bremsstrahlung emission, 16: 26348
SAETTA, E. Menichella, Statistical emission in nuclear reactions, 16: 26516
SAINFORT, Gerard, Fragility of Fe–Al solid solution, 16: 25776
ST. CIN, George E., Gas cooled reactor study, 16: 26497 (TID-16138)
ST. LORANT, S. J., Example of ${}_4Be^7$ hypernucleus, 16: 26312
SAITO, Tetsuya, Beta-decay of Λ and Σ^- hyperons, 16: 26167
SALAM, Abdus, Elementary particle resonances, 16: 26155
SALAM, Abdus, Unitary symmetry, 16: 26156
SALEM, L., Reliability of Hellmann-Feynman theorem, 16: 25970
SALERNO, Paul R., Effect of actinomycin D and x radiation, 16: 25232
SALESSE, Marc, Fragility of Fe–Al solid solution, 16: 25776
SALISBURY, S. R., Fluorine-17 level parameters, 16: 26324

SALISBURY, S. R., Proton-oxygen differential scattering cross sections. II., 16: 26323
SALMON, Alan James, Apparatus for detecting radioactivity in fluid, 16: 25596
SALMON, Alan James, Apparatus for measuring radiation produced in reactors, 16: 25597
SALMON, Alan James, Apparatus for detecting radioactivity in fluid, 16: 25598
SALTANOV, N. V., Riemann waves, 16: 26436 (FTD-TT-62-354)
SALVADORI, P., Photoproduction of neutral mesons, 16: 25898 (LNF-62/37 (p.98-104))
SALVADORI, P., Photoproduction of π^0 mesons from H_2, 16: 25936 (NP-11977(p.102-4))
SALVAGGIO, G. J., Properties of Hf from PWR control rod, 16: 25854 (WAPD-TM-336)
SALVINI, G., Cross section of the process $\gamma + p \rightarrow \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
SALVINI, G., Polarization of recoil protons, 16: 25939 (NP-11977(p.111-15))
SALVINI, G., Scintillation chambers, 16: 25940 (NP-11977(p.116-20))
SALVINI, G., Study on the process $\gamma + p \rightarrow \eta + p$, 16: 25897 (LNF-62/37 (p.89-98))
SAM, D., Gamma spectra of Te-133m and Te-134, 16: 26239
SAMIOS, N. P., Decay of negative hyperon, 16: 26141
SAMPSON, Douglas H., Electron distribution function of ionized gas, 16: 25951 (R62SD64)
SAMSONOV, G. V., Analysis of high-melting alloys, 16: 25835
SAMSONOV, G. V., Hard compounds of refractory metals, 16: 25768 (NASA-TT-F-102)
SAMUEL, A. H., Prog. rpt. on organic liquid radiation stability, 16: 25420 (SRIA-62)
SANCHO, F. J., Adiabatic invariance in quantum mechanics, 16: 26448
SANDBERG, R.O., Design of CVTR pressure tube, 16: 26585 (CVNA-95)
SANDENAW, Thomas A., Rate of heat generation of Pu, 16: 25802
SANDERS, L. G., Direct conversion of fission heat to electric power, 16: 25972
SANDERS, L. G., Energy transformation using thermionic emission, 16: 25971
SANDERSON, E. A., Inelastic proton scattering on C, 16: 26279
SANNA, G., Mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
SANNA, G., Measurement of mean life of π mesons, 16: 25901 (LNF-62/37 (p.118-38))
SANO, A., Pulse scaler and ferrite core preselector, 16: 25563 (NP-11735)
SANO, A., TIMER—Programmer with ferrite cores, 16: 25564 (NP-11822)
SANO, Y., Mixing velocity in powder mixes, 16: 25512 (NP-tr-887)
SANO, Y., Mixing particles using ribbon blender, 16: 25514 (NP-tr-889)
SANTOLI, P. A., Prog. rpt. on Mo alloy extrusion, 16: 25729 (ASD-TR-7-785(VI))
SAPP, R. C., Nuclear alignment of Ce-141 in Ce Mg nitrate, 16: 26224 (NP-11865)
SARACENO, F., Phase equilibria in U-rich binary alloys, 16: 25785
SARKISVAN, L. A., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
SARUIS, A. M., Neutron fission product cross sections, 16: 26518
SARYCHEV, V. M., Motion of thermally inequilibrate plasma, 16: 26430
SASAKI, Yasuichi, Acid leaching of Th carbide, 16: 25365
SATO, K., Heat of formation of U_3O_7, 16: 25378
SATO, K., Specific heat of U carbides, 16: 25379
SAUER, J. A., Prog. rpt. on radiation effects on polymers, 16: 25853 (TID-16273)
SAVAGE, H. C., Radiation effects on thoria–urania slurries, 16: 26494 (TID-7622(p.282-99))
SAVINTSEV, P. A., Contact melting of irradiated crystals, 16: 25868
SAWICKI, J., Giant E1 resonance for deformed nuclei, 16: 26253 (UCRL-9803)
SAWICKI, J., RPA and energy spectra of spherical nuclei, 16: 26330
SAYERS, J., Ionic recombination, 16: 26032
SCARASCIA, G. T., Effects of x rays on *Nicotiana tabacum*, 16: 25193 (CNEN-118)
SCARASCIA, G. T., Mutations induced by radiation in wheat, 16: 25196 (CNEN-120)
SCHABLASKE, R. V., Crystal structures of TiCd and Ti_2Cd, 16: 25828
SCHANER, B. E., Study of UO_2–ZrO_2 system, 16: 25765 (WAPD-253)
SCHEARER, L. D., Nuclear polarization of He-3 gas, 16: 26332
SCHECTER, Larry, Directional correlation in Ti-46, 16: 26256
SCHEER, Milton D., Vacuum photolysis of solid ethane, 16: 25437
SCHEIBLING, F., Transitions in O-16, 16: 26301
SCHEIBLING, F., Transition in B-11, 16: 26302
SCHENKEL, Gotardo, Heavy water in Chile, 16: 25621
SCHERER, James R., Force field for condensed aromatic rings, 16: 25346
SCHIAVUTA, E., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37(p.76-80))
SCHIAVUTA, F., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
SCHIFFMAN, R. H., Movement of Sr across the gill of trout, 16: 25116 (HW-72500(p.23-5))
SCHMIEGE, Clement C., Packaging for radiation pasteurized foods, 16: 25681 (TID-15144)
SCHMITT, A. P., Physical research on RAPSODIE, 16: 26569
SCHMITT, R. A., Prog. rpt. on rare-earth abundances in meteorites, 16: 25648 (GA-2782(Rev.))
SCHNOPPER, Herbert W., Alignment procedures in x-ray spectrometry, 16: 25545 (AFOSR-2418)
SCHNOPPER, Herbert W., Excitation and ionization of inner atomic shells by x rays, 16: 25873 (AFOSR-1732)
SCHOENIGER, Ernest L., Effect of actinomycin D and x radiation, 16: 25232
SCHOOLEY, J. F., Gamma distribution from Ce-141, 16: 26242
SCHREITER, H., Aluminescence of Sr borate phosphors, 16: 25975
SCHRIEFFER, J. R., Effect of collective excitations on single particle spectra, 16: 26269
SCHUBERT, Jack, Chemical modification of radiation toxicity, 16: 25174 (TID-11988)
SCHUCH, A. F., Structure of the γ form of solid He-4, 16: 25994
SCHUELE, Wolfgang, Apparatus for measuring electrical resistance, 16: 25769 (SCL-T-434)
SCHULTZ, J., Dislocation relaxation spectra of cold-worked b.c.c. transition metals, 16: 25807 (GA-1745)
SCHUMANN, W. A., Transient and steady-state temperature in one-barrel cask, 16: 26471 (NAA-SR-Memo-6938)
SCHUR, S., Identification of stratospheric aerosols, 16: 25609 (AFCRL-62-299)
SCHWARTZ, Charles M., Reactions between U oxide and bivalent metal oxides, 16: 25302 (BMI-1585)
SCHWARTZ, M., Existence of two kinds of neutrinos, 16: 26147
SCHWARZ, Henry P., Prog. rpt. on effects of x rays on lipids of skin, 16: 25178 (TID-16131)
SCHWEITZER, D. G., Liquid-metal fuel constitutions. IV., 16: 25815 (BNL-5156)
SCHWEITZER, Donald G., Thermal properties of air-cooled graphite channels, 16: 25534 (BNL-5522)
SCHWIENING, Carroll Sue, Radiation effects on semiconductor devices, 16: 25842 (LAMS-2706)
SCINTEI, N., Angular correlations in $S^{32}(p,p'\gamma)$, 16: 26327
SCINTEI, N., Scattering of low energy protons on S-32, 16: 26352
SCOTT, R. R., Solar cell array optimization, 16: 25080 (ASD-TR-61-11 (Vol.I))
SEATON, M. J., Ionization by electron impact, 16: 26035
SECREST, A. C., Ceramic-coated nuclear-fuel particles, 16: 26476 (TID-7622(p.57-73))
SECREST, V. M., Ceramic-coated nuclear-fuel particles, 16: 26476 (TID-7622(p.57-73))
SEIDLER, H., Simple counter arrangements for weak activities, 16: 25584
SELEKTOR, Yu. M., Elastic scattering of 7.2-Bev π^- mesons on protons, 16: 26180
SELIG, Henry, Magnetic susceptibility of ReF_6, 16: 25347
SELLERI, F., Double photoproduction reactions, 16: 25887 (LNF-62/37 (p.7-9))
SELZ, A., Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
SEMAGIN, V. N., Nervous system in mature rats exposed during embryonic period, 16: 25241
SENS, J. C., Magnetic moment of the muon, 16: 26115
SEREBRYAKOV, V. V., Narrow pion-pion resonance, 16: 26118

SERGEEV, F. M., Elastic π^- meson scattering on C, 16: 26365
SERRA, A., Pulse scaler and ferrite core preselector, 16: 25563 (NP-11735)
SERRA, A., TIMER—Programmer with ferrite cores, 16: 25564 (NP-11822)
SESONSKE, Alexander, Heat transfer in Na–K alloy, 16: 25535
SETTLE, J. L., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
SETTLE, Jack L., Fluorine bomb calorimetry. IV., 16: 25360
SEVERI, M., Photoproduction of K mesons in H_2, 16: 25947 (NP-11977 (p.137-9))
SHABLYGIN, M. V., Radiation polymerization of vinyl monomer on fiber, 16: 25431
SHAFFER, J. H., Preparation of high-purity BeO, 16: 26481 (TID-7622 (p.122-7))
SHAH, S. K., Binding energy of hypernuclei. I., 16: 26344
SHAIN, Irving, Determination of I with Ag microelectrodes, 16: 25279
SHAKHIDZHANYAN, L. G., Cesium and Sr in human organs, 16: 25157
SHALAMOV, Ye. Ye., Resonance in a $K^0\Lambda^0$ system at 1650 Mev, 16: 26189
SHANKAR, J., Isotopic exchange in cobaltous–cobaltic system, 16: 25353
SHAPIRO, Anatole M., Prog. rpt. on high-energy physics, 16: 25952 (TID-16011)
SHAPIRO, V. D., Electric conductivity and temperature of plasma, 16: 25962 (JPRS-13656(p.177-92))
SHAPIRO, V. D., Interaction between charged particle beams and plasma in magnetic field, 16: 26428
SHARDANOV, A. Kh., Reaction $Li^7(\gamma,p)He^8$, 16: 26353
SHARMA, C. S., Correlation energies for 1s2s ^3S and ^1S states of He-like ions, 16: 26004
SHATENSHTEIN, A. I., Isotopic exchange, 16: 25372
SHAW, A. L., British commercial nuclear power today, 16: 26606
SHAW, John R., Rapidly variable processes in plasma, 16: 26406 (NP-tr-883)
SHEFFIELD, C., Systems of finite height, 16: 26500
SHEINDLIN, A. E., Enthalpy of W, 16: 25779
SHEINKER, A. P., Mechanism of radiation polymerization. I., 16: 25457
SHEINKER, A. P., Mechanism of radiation polymerization. II., 16: 25458
SHELINE, R. K., Levels of Os-188, 16: 26286
SHER, E. H., Controlled ground explosion, 16: 25640
SHER, Rudolph, Analysis of parameters of U-233, U-235, and Pu-239, 16: 26216 (BNL-722)
SHERBY, Oleg D., Atomic mobility in metallic systems, 16: 25816
SHERIF, F. G., Uranyl azide complexes, 16: 25352
SHERMAN, N. K., Superconducting nuclear particle detector, 16: 25590
SHERRILL, F. A., Radiation effects in U-doped zirconia, 16: 25861
SHEVALEEVSKII, I. D., Zirconium and Hf ratio in zircon, 16: 25629
SHEVALEEVSKII, I. D., Zirconium–Hf ratio in minerals and rocks, 16: 25631
SHEVCHENKO, V. G., Reaction $Li^7(\gamma,p)He^6$, 16: 26353
SHEVCHENKO, V. I., Interaction between charged particle beams and plasma in magnetic field, 16: 26428
SHEVLIN, Thomas S., Uranium oxide pressure-temperature-composition relationships, 16: 26483 (TID-7622(p.139-48))
SHEWCHUCK, Sergey, Crystal structure of BeO, 16: 25770 (UCRL-Trans-826(L))
SHEWCHUCK, Sergey, Volume effect by corrosion of Si single crystal, 16: 25722 (UCRL-Trans-830)
SHIELDS, R. P., Release of fission products on in-pile melting of reactor fuels, 16: 26488 (TID-7622(p.207-15))
SHIGETOMI, S., Effects of radiation on glycolytic action, 16: 25234
SHILLING, W. A., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
SHIMAMURA, H., Irradiation of Yoshida sarcoma cells, 16: 25220
SHIMCHAK, R. A., Production of At-209 and At-207, 16: 26220 (JINR-P-950)
SHIMODAYA, Ichiro, Interaction between α particles, 16: 26171
SHIN, E. E. H., Optical and infrared properties of metals, 16: 25758 (NP-11675)
SHINNO, M., Effects of orotic acid on radiation injuries, 16: 25257
SHIOAKI, M., Cytotoxin produced by irradiation. I., 16: 25224
SHIPKO, F., Coatings for UO_2 and U particles, 16: 26479 (TID-7622(p.98-107))
SHIPP, D. J., Pyrolytic graphite rocket nozzle components, 16: 25728 (AD-270153)
SHIRAKAWA, U., Mixing particles using ribbon blender, 16: 25514 (NP-tr-889)
SHIRANE, G., Neutron diffraction of Fe_2O_3–V_2O_3, 16: 25366
SHIRKOV, D. V., Narrow pion-pion resonance, 16: 26118
SHIRTS, Monte B., Oxygen solubility in water and thoria slurries, 16: 25324 (TID-16392)
SHISHKOV, Yu. D., Chemistry and production of U fluoride compounds, 16: 25470
SHOKHIN, I. A., Gamma-induced degradation of butyl rubber, 16: 25869
SHOLETTE, W. P., Collisions of He atoms in gases, 16: 26238
SHOR, A. J., Radiation effects on thoria–urania slurries, 16: 26494 (TID-7622(p.282-99))
SHOSHIN, P. B., Size of electron bunch during operation of synchrotron, 16: 26395
SHTEPTAN, V. E., (Ye.), Ionized meteor train, 16: 26047 (FTD-TT-62-165)
SHUKOLYUKOV, Yu. A., Age of radioactive minerals, 16: 25626
SHVABE, E., Annular phasotron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
SIEKIERSKA, K. E., Reaction of neutron activated As atoms. II., 16: 25441
SIEKIERSKI, S., Extraction of Eu and Th nitrates, 16: 25489
SIEKIERSKI, Slawomir, Influence of diluent on extraction of Fe(III), 16: 25481 (PAN-303/V)
SIGNELL, Peter, Non-static effects in OPEP, 16: 26166
SIKLOS, T., Properties of transuranic elements, 16: 26217 (JINR-E-932)
SIKOV, Melvin R., Responses of rat embryos to radiation, 16: 25231
SILIN, V. P., Rapidly variable processes in plasma, 16: 26406 (NP-tr-883)
SILVER, B., Oxidation of phosphorous acid, 16: 25361
SILVER, M., Thermodynamic properties of Zr–O, Ti–O, and Hf–O alloys, 16: 25384
SILVESTRINI, G. V., Polarization of recoil protons, 16: 25939 (NP-11977(p.111-15))
SILVESTRINI, G. V., Scintillation chambers, 16: 25940 (NP-11977(p.116-20))
SILVESTRINI, V., Cross section of the process $\gamma + p \to \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
SILVESTRINI, V., Study on the process $\gamma + p \to \eta + p$, 16: 25897 (LNF-62/37(p.89-98))
SILVESTRO, F., Mineralization of U, 16: 25634 (CNEN-53)
SIMMONS, R. E., Determination of C in UF_4, 16: 25283 (TID-12773)
SIMMONS, R. O., Point defects in deformed f.c.c. metals, 16: 25764 (TID-16222)
SIMNAD, Massoud T., Atomic mobility in metallic systems, 16: 25816
SIMONS, E. M., Reactor Materials, Vol. 5, No. 2, 16: 25709
SIMONS, L., Gamma-gamma cascades of Dy-160, 16: 26346
SIMPSON, S. M., Jr., Underground nuclear detection, 16: 25610 (AFCRL-863)
SIMS, G. H. E., Solvent extraction of Be, 16: 25475 (NCL/AE-172)
SIMS, T. M., Personnel-exposure and contamination control in operation of research reactors, 16: 25654 (ORNL-TM-278)
SINCLAIR, Daniel, Form factors in $K_{\mu 3}$ and K_{e3} decay, 16: 26135
SINCLAIR, V. M., Impurities in liquid metal coolant and their effect on Nb and V, 16: 26475 (TID-7622(p.35-56))
SINCLAIR, V. M., Preliminary work on Mo species in nitric acid, 16: 25311 (IG-Memo-466)
SINGER, Irving A., Wind profile in lower 400 ft of atmosphere, 16: 25611 (BNL-718)
SINGER, Paul, Decay modes of the η meson, 16: 26138
SINGH, Virendra, Model for decays of Σ and Λ hyperons, 16: 26131 (UCRL-9863)
SINGLETON, N. R., Control rods and drive mechanisms for CVTR, 16: 26589 (CVNA-121)
SIRONI, G. P., X-ray induction of dominant lethals, 16: 25192 (CNEN-121)
SKACHKOV, Yu. F., Spark counters with plane-parallel electrodes, 16: 25575 (AEC-tr-5239)
SKIDMORE, I. C., Equation of state data for U, 16: 25376
SKILBREID, O., Search for β^- decay of Hf-180m, 16: 26255
SKILLICORN, I. O., Decay of negative hyperon, 16: 26141
SKINNER, H., Determining heats of formation, 16: 25404
SKLAROFF, D. M., Radioisotope scanning of liver and spleen, 16: 25101
SKOBEL'TSYN, D. V., Cosmic rays, 16: 26061
SKURATOV, S. M., Heats of formation of Nb_2O_5 and Ta_2O_5, 16: 25334
SLAVNOV, D. A., Exclusion of divergences from scattering matrix,

16: 26181
SLIFKIN, Lawrence M., Delineation of tracks of cosmic rays, 16: 25546 (AFOSR-3030)
SLIGH, John L., Coatings for refractory metals, 16: 25701 (WADD-TR-61-64)
SLOBODRIAN, R. J., Magnetic deflector system of synchrocyclotron beam, 16: 26373 (NP-11693)
SLOBODRIAN, R. J., Magnetic deflector of synchrocyclotron beam, 16: 26374 (NP-11889)
SLOOTEN, H. S. G., Irradiation experiments with PuO_2 and $ThO_2 \cdot UO_2$, 16: 26493 (TID-7622(p.263-81))
SLOTH, Eric N., Isolation of I without carrier, 16: 25264 (ANL-6577)
SMIRNITSKAYA, G. V., Multi-beam high-vacuum gas discharge pump, 16: 25511 (FTD-TT-62-370)
SMIRNOV, E. A., Properties of Zr and its alloys with Sn, 16: 25406
SMIRNOV, V. I., Turbulent flow in circular tubes, 16: 25529 (AEC-tr-5214)
SMITH, A., Fission properties utilized in reactor design, 16: 26512
SMITH, A. B., Microscopic fast-neutron interactions, 16: 26505 (TID-13546)
SMITH, D. C. G., Physics of Dounreay Fast Reactor, 16: 26566
SMITH, E. A., Hexafluorides of Mo, W, and U. I., 16: 25339 (GAT-T-969)
SMITH, F. M., Loading Sr-90 on Decalso for cask shipment, 16: 25651 (HW-71574)
SMITH, Frances M., Leptonic Σ^+ decay, 16: 26143
SMITH, Gerald A., Strange-particle resonant states, 16: 26134
SMITH, Henry J., Chromospheric striation obscuration by great flare, 16: 26046 (AFCRL-834)
SMITH, Hilton A., Catalytic reactions on semiconductors, 16: 25355
SMITH, J. P., Oxidation of Be intermetallic compounds, 16: 25723
SMITH, L. L., Extraction of U, Pu, Ru, Zr, 16: 25482 (AEC-tr-5197)
SMITH, Lowell R., Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
SMITH, M. J. A., Electron resonance studies on irradiated AgHr, 16: 25867
SMITH, O. G., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
SMITH, R. H., Determination of Fe and U, 16: 25281
SMITH, R. H., Prog. rpt. on rare-earth abundances in meteorites, 16: 25648 (GA-2782(Rev.))
SMITH, R. R., Stability of EBR-I, 16: 26558
SMITH, S. E., Inert atmospheres, 16: 25517
SMRZ, P., Meson emission, 16: 26096
SMULEK, Viktor, Influence of diluent on extraction of Fe(III), 16: 25481 (PAN-303/V)
SMULLIN, L. D., Generation of dense plasma, 16: 26417
SNOW, George A., Reactions $\beta + p \rightarrow K + \bar{K} + X_0$, 16: 26121
SOBENIN, N. P., Absorbing load for diaphragm-type waveguide, 16: 26388 (FTD-TT-61-242(p.151-61))
SOBENIN, N. P., Coupling phasometer circuit to diaphragm-type waveguide, 16: 26389 (FTD-TT-61-242(p.147-50))
SOBENIN, N. P., Phasometer circuits, 16: 26387 (FTD-TT-61-242(p.134-46))
SOKOLOV, S. H., S-matrix for one-dimensional Schroedinger equation, 16: 26435 (JINR-P-906)
SOKOLOVA, E. S., Production of ΛK^0 and $K^0\bar{K}^0$ pairs in $\pi^- p$ interactions, 16: 26068 (JINR-D-965)
SOKOLOWSKA, A., Reaction of neutron activated As atoms. II., 16: 25441
SOLANES, M., Multi-group calculations for fast reactors, 16: 26537
SOLANES, M., Neutron-flux propagation in fast reactors, 16: 26531
SOLANES, M., Physical research on RAPSODIE, 16: 26569
SOLDAINI, G., Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
SOLOMON, Irvine J., Properties of Li ozonide, 16: 25338
SOLOV'EV, L. D., Unobserved region in photoproduction dispersion ratios, 16: 26073 (JINR-P-904)
SOLOV'EV, M. I., Production of ΛK^0 and $K^0\bar{K}^0$ pairs in $\pi^- p$ interactions, 16: 26068 (JINR-D-965)
SOLOV'EV (SOLOVIEV), V. G., Properties of transuranic elements, 16: 26217 (JINR-E-932)
SOLOV'EV, V. G., Alpha decay rates, 16: 26308
SOMBERT, C., Vitrification of solutions of fission products, 16: 26634 (CEA-2130)
SOMERVILLE, W. B., Correlation energies of He sequence, 16: 26005
SOMMERHALDER, R., Magnetic field penetrating a superconductor, 16: 25997
SOODAK, H., Reactivity effect of H_2 addition, 16: 26544
SOPER, J. M., Isotopic spin purity in heavy nuclei, 16: 26304
SORSKY, Gideon, Thermocouple cables, 16: 25599
SOWA, E., Safety programme in Treat, 16: 26564
SOWDEN, R. G., Irradiation experiments with PuO_2 and $ThO_2 \cdot UO_2$, 16: 26493 (TID-7622(p.263-81))
SPEDDING, F. H., Heat capacity anomaly in Tb, 16: 25993
SPEICH, G. R., Precipitation of Laves phases, 16: 25827
SPEISER, Evelyn W., Nuclear-electric spacebus, 16: 26628 (JPL-TR-32-231)
SPEKTOR, A. Ts., Verification of Fe–Zr phase diagrams, 16: 25829
SPENCER, A. M., Transient electrode potentials of Ni, 16: 25322 (TID-16292)
SPINK, K., Exploration for coal γ/γ log, 16: 25637
SPIRA, Jack, Electron beam 10-35 Mev betatron doses, 16: 25189
SPITSYN, Viktor I., Radiolysis of Rh compounds, 16: 25430
SPRING, E., Gamma-gamma cascades of Dy-160, 16: 26346
SPRINGELL, P. H., Studies of protein structure, 16: 25332
SRIKANTIAH, G., Correlation of integral experiments and high-energy cross-sections, 16: 26532 (BNL-5604; BNL-5892)
STACHOWICZ, Waclaw, Radiation yield of hydrogen in deuterated "Neda", 16: 25416 (PAN-289/ChR)
STADELMAIER, H. H., Cobalt end of Co–Al–B system, 16: 25793
STAIR, William K., Labyrinth seal; theory and design, 16: 25505 (TID-15986)
STAIR, William K., Vinco seal, survey, 16: 25506 (TID-15987)
STANGHELLINI, A., Asymptotic properties of scattering, 16: 26116
STANYUKOVICH, K. P., Bodies radiating gravitational waves, 16: 26176
STARFELT, N., Absolute measurement of $\bar{\nu}$ of Cf-252, 16: 26515
STARIK, A. S., Cesium and Sr in human organs, 16: 25157
STARITSYN, V. E., Small neutron diffractometer, 16: 25593
STAVINSKII, V. S., Fission threshold fragment excitation energies in drop model, 16: 26361
STAVITSKII, R. V., Dosimetric apparatus in sanitation practice, 16: 25665
STEED, K. C., Methods in radiochemical analysis. II., 16: 25285
STEENBERG, N. R., Nuclear cross sections at high energies, 16: 26274
STEHLIK, G., Research reactor Astra, 16: 26623
STEIGERT, F. E., Scattering of O ions from Ar and Xe, 16: 25990
STEINBERG, Meyer, Polymerization of ethylene by γ rays, 16: 25409 (BNL-740)
STEINBERGER, J., Existence of two kinds of neutrinos, 16: 26147
STEINER, Bruce, Photoionization of alkyl free radicals, 16: 25435
STEPANOV, A. V., Scattering of slow neutrons in crystals, 16: 26203 (AEC-tr-5145)
STEPHAN, Elmer F., Corrosion of Th and U, 16: 25713 (BMI-1563)
STEPHAN, Elmer F., Helium solubility in D_2O, 16: 25303 (BMI-1587)
STEUNENBERG, R. K., Dissolution of U in U–U oxides, 16: 25483 (UAC-4745)
STEWART, A. L., Allowed transitions, 16: 26026
STEWART, A. L., Correlation energies of He sequence, 16: 26005
STEWART, J. D., Uptake of arsenate by barley plants, 16: 25138 (HW-72500(p.119-22))
STEYERT, W. A., Paramagnetism of Fe impurities in transition metals, 16: 25999
STIEGLER, J. O., Radiation effects in U-doped zirconia, 16: 25861
STIENING, R., Cross section of the process $\gamma + p \rightarrow \pi^0 + p$, 16: 25890 (LNF-62/37(p.28-34))
STIENNON-BOVY, R., Bibliography on Te-132, 16: 25301 (BLG/B-1)
STIENNON-BOVY, R., Paper chromatography of Te(IV) and Te(VI), 16: 25265 (BLG/B-4)
STILLER, M., Determination of Te in presence of Bi, 16: 25267 (IA-724)
STOCK, John T., Prog. rpt. on analytical chemistry, 16: 25272 (TID-16332)
STOCKDALE, J. A., Quasi-trapping of electrons in water vapor, 16: 25973
STOHR, J., Ceramic fuels in France, 16: 25703 (AEC-tr-5216)
STOLL, I., Stability of periodic processes in plasma, 16: 26407
STOPPA, C., Determination of rare earths in U compounds, 16: 25266 (CNEN-135)
STOPPINI, G., Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37(p.105-6))
STORRER, F., Structural distortion effect on reactivity, 16: 26555
STOUTE, R. L., Heat transfer coefficient between UO_2 and Zy-2, 16: 25523 (CRFD-1075)

STRAUSS, U. P., Prog. rpt. on inorganic amphipathic compounds, 16: 25317 (NYO-9837)
STRAX, N., Measurement of the triple scattering parameter, 16: 26140
STREEVER, Ralph L., Jr., Nuclear moment of Ni-61, 16: 26322
STRICKLAND, R. E., Magnox reactor optimization, 16: 26607
STRNAD, J., Quasi-elastic proton scattering on Li-7 and C-12, 16: 26273
STROHM, W. W., Jr., Nuclear alignment of Ce-141 in Ce Mg nitrate, 16: 26224 (NP-11865)
STROKE, H. H., Nuclear isomer shift in Hg-195, 16: 26331
STRUTINSKII, V. M., Shapes of nuclei in quasistatic fission model, 16: 26358
STUART, M., Evaluation of U^{233}–Th breeder power reactors, 16: 26613 (NDA-2164-3)
STUDIER, Martin H., Isolation of I without carrier, 16: 25264 (ANL-6577)
STUMP, F. C., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
STURM, Bernard J., Chromium(II) fluoride–chromium(III) fluoride, 16: 25340
SUBRAMANIAN, R., Frequency response of ion chamber, 16: 25587
SUDARIKOV, B. N., Chemistry and production of U fluoride compounds, 16: 25470
SUDARSHAN, E. C. G., Spurious scattering in nuclear emulsions, 16: 26090 (NYO-10233)
SUDO, Toshio, Microscopic analysis of inorganic substances, 16: 25275 (AEC-tr-5194)
SUGAWARA, M., N/D method, 16: 26132
SUGAWARA, T., Effects of AET on genetic death due to radiation, 16: 25211
SUGIHARA, T. T., Separating Cs, 16: 25485
SULLIVAN, M. F., Delayed effects of Y-90 ingestion, 16: 25131 (HW-72500(p.88-91))
SULLIVAN, M. F., Protection against repeated partial-body irradiation, 16: 25129 (HW-72500(p.81-3))
SUNAKAWA, Sigenobu, System of interacting Bose particles. I., 16: 26162
SUNAKAWA, Sigenobu, System of interacting Bose particles. II., 16: 26163
SUND, L., Slowing down of (D,D) neutrons in paraffin wax, 16: 26210
SUNDERMAN, D. N., Xenon-133 diffusion in alumina, 16: 26491 (TID-7622 (p.245-53))
SUNDERMAN, Duane N., Determination of short-lived fission-product gases, 16: 25295
SUNDHEIM, Benson R., Alkali metals in ethylenediamine, 16: 25357
SURANYI, P., Mandelstam's equations for π-σ scattering, 16: 26069 (JINR-E-943)
SUTTER, G., Transitions in O-16, 16: 26301
SUTTER, G., Transition in B-11, 16: 26302
SUWALSKI, Jan, Radiation damage for study of properties of Ge, 16: 25849 (PAN-314/I-B)
SUWALSKI, Jan., Scattering of holes in Ge by fast neutrons, 16: 25850 (PAN-315/I-B)
SUZUKI, K., Equilibrium between H_2 gas and PuH_2 phase, 16: 25380
SVECHNIKOV, V. N., Verification of Fe–Zr phase diagrams, 16: 25829
SVOBODA, Karel, Cosmic radiation, 16: 26053
SWEZEA, E. G., Prog. rpt. on biology, 16: 25111 (HW-72500)
SWIATECKI, Wladyslaw J., Prompt neutrons from spontaneous fission of Cf-252, 16: 26320 (UCRL-9713(Rev.))
SWIDERSKI, E. F., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
SWIECA, J. A., Field propagators, 16: 26442
SWIECKI, Jeremi, Treatment of radiation sickness, 16: 25259
SWIFT, L. M., Shotpoint medium and seismic coupling, 16: 25632 (UCRL-6054)
SYDORIAK, Stephanie M., Determination of V, 16: 25276 (AEC-tr-5250)
SYKES, J. B., Fundamentals of film dosimetry, 16: 25658 (AERE-Trans-895)
SYMONS, G. D., Deuterons elastically scattered from C, 16: 26338
SZEGO, L., Solvent extraction of mono(salicylato)beryllium, 16: 25486
SZENTPETERY, I., Circular polarization of γ quanta, 16: 26267
SZEPKE, R., Plants as radioactive monitors, 16: 25644 (CLOR-9)
SZILAGYI, Maria, Contaminations of P-32 preparations, 16: 25448

T

TABARDEL-BRIAN, R., Measurement of integrated doses by mechanography, 16: 25550 (CEA-2128)
TABELLINI, G. L., Instrumentation for space research, 16: 25588
TABER, A. P., Equipment for low-cycle fatigue tests, 16: 25606 (TID-15356)
TAGAYA, F., Chemical agents against radiation injuries. I., 16: 25256
TAKAHASHI, Atsushi, Pion-nucleon scattering, 16: 26169
TAKAHASHI, Hisao, Gamma dose rates in Japan, 16: 25675
TAKAHASHI, T., Breakage of chromosomes by radiation. V., 16: 25209
TAKAHASHI, T., Radiosensitivity of Yoshida ascites sarcoma, 16: 25221
TAKAHASHI, Tsu, Hydrogen counter for H-3, 16: 25592
TAKAHASHI, Y., Field quantization and statistics, 16: 26443
TAKEBE, Hisao, Sakata model and the K_{l3} + decays, 16: 26160
TAKEDA, Y., Effects of AET on genetic death due to radiation, 16: 25211
TAKEI, W. J., Neutron diffraction of Fe_2O_3–V_2O_3, 16: 25366
TAKETANI, Kiyoshi, Thermal cycling effect of U, 16: 25766 (AEC-tr-5076)
TAKEUCHI, Masashi, Gamma dose rates in Japan, 16: 25675
TAKEUCHI, S., Equilibrium between H_2 gas and PuH_2 phase, 16: 25380
TALANOV, V. I., Theory of surface EM waves, 16: 25959 (JPRS-13656 (p.1-91))
TALMI, Igal, Neutron $d_{3/2}$" configurations in Zr isotopes, 16: 26319
TAMAGAKI, Ryozo, Interaction between α particles, 16: 26171
TAMBOVTSEV, D. I., Proton polarization in stripping reaction on B-10, 16: 26347
TAMURA, Toro, Collective E3 and E4 transitions in spherical nuclei, 16: 26271
TANAKA, Hajime, Interaction between α particles, 16: 26171
TANAKA, S., Angular distributions of fast neutrons, 16: 26507
TANAKA, T., Changes of plasmin activity caused by radiation treatment, 16: 25161
TANG, Y. C., Beryllium-9 in cluster model, 16: 26272
TANGRI, K., Lattice strains in β-quenched U, 16: 25788
TANI, B. S., Crystal structures of TiCd and Ti_2Cd, 16: 25828
TATLOCK, John, Support structure, 16: 26579
TAU, L., Photoproduction of μ-meson pairs in C, 16: 25899 (LNF-62/37 (p.105-9))
TAUBE, M., Synergetic effects on Pu extraction systems, 16: 25480 (PAN-270/V)
TAYLOR, A. E., Nucleon-nucleon total cross sections, 16: 26145
TAYLOR, Anthony James, Reactor heat generating and utilizing plant, 16: 26611
TAYLOR, Anthony James, Shock absorbers, 16: 26572
TAYLOR, Ellison H., Catalytic reactions on semiconductors, 16: 25355
TAYLOR, R. D., Paramagnetism of Fe impurities in transition metals, 16: 25999
TAYLOR, R. E., Prog. rpt. on thermal properties of refractories, 16: 25837 (AD-270841)
TAYLOR, R. T., Pion-nucleon coupling constant, 16: 26105
TAZZARI, S., Measuring the reaction $e^+ + e^- = K^+ + K^-$, 16: 25906 (LNF-62/37(p.166-79))
TAZZARI, S., Photoproduction of π^+, 16: 25891 (LNF-62/37(p.34-9))
TAZZARI, S., Photoproduction of π^+ with polarized photons, 16: 25935 (NP-11977(p.99-100))
TAZZARI, S., Photoproduction of K^+, 16: 25946 (NP-11977(p.135-7))
TELLER, Andrew S., Liquid metal boiling, 16: 25522 (ASD-TR-61-594)
TEMMER, G. M., Prog. rpt. on physics, 16: 25910 (NP-11749)
TEMMER, G. M., Resonant transfer processes in reactions, 16: 26299
TERMAN, A. V., Sanitary-hygienic requirements of centers of radioactive isotopes, 16: 25661 (JPRS-13691(p.13-19))
TEWS, Joan L., Separating Ta and Nb, 16: 25492
THALGOTT, F. W., Results with metallic and ceramic fuels, 16: 26524
THALGOTT, F. W., Stability of EBR-I, 16: 26558
THEILACKER, J. S., Control rod material, Ag–In–Cd, 16: 25796
THIELHEIM, K. O., Interpretation of jets, 16: 26056
THODOS, George, Mass and heat transfer through fixed and fluidized beds, 16: 25532
THOMAS, D.R., Development of the CVTR moderator tank, 16: 26586 (CVNA-108)
THOMAS, J., Fast-neutron spectra, 16: 26530
THOMAS, J. R., Determination of Mo–U ratios in hexafluoride mixtures, 16: 25313 (K-1433)
THOMPSON, R. C., Delayed effects of Y-90 ingestion, 16: 25131 (HW-72500(p.88-91))

THOMPSON, R. C., Protection against repeated partial-body irradiation, 16: 25129 (HW-72500(p.81-3))
THOMPSON, Stanley G., Prompt neutrons from spontaneous fission of Cf-252, 16: 26320 (UCRL-9713(Rev.))
THORLEY, A., Embrittlement of Nb in H contaminated NaK, 16: 25402
THORN, R. J., Thermodynamic properties of compounds of actinide elements, 16: 25398
THORN, R. J., Vaporization studies of UC_x phase, 16: 25393
THORN, R. J., Vaporization and thermodynamic properties of US and UOS, 16: 25399
THORN, R. J., Vaporization properties of Th, U, and Pu metals and oxides, 16: 25400
THORP, A. G., II, Cruciform control rod joint, 16: 26574
THORPE, D. F., Elution of U from anion exchange resins, 16: 25463 (ACCO-12)
THUNGA, R., On Y* resonances, 16: 26111
TICHY, J., Influence of radiation on piezoelectric resonators, 16: 25857
TICKLE, R. S., Prog. rpt. on 83-inch cyclotron, 16: 26375 (TID-16329)
T'IEH, Tu Lich, Geochemistry of U and Th, 16: 25627
TIKHOMIROV, V. B., Principal processes and equipment in U production, 16: 25471
TILLEUX, E. W., High-temperature heat contents of refractory borides, 16: 25401
TIMIN, M. E., Analysis of radial arm indexing mechanism. Top transfer machine, 16: 26465 (GAMD-1318)
TIMUSHEV, G. F., Proton absorption by Cu-63, 16: 26349
TING T'I, Nguyen, Production of ΛK^o and K^oK^o pairs in π^-p interactions, 16: 26068 (JINR-D-965)
TIPTON, L. L., Prog. rpt. on space electric power systems, 16: 26629 (NP-11728)
TITTERTON, E. W., Half lives of C-10 and Ne-19, 16: 26244
TITTERTON, E. W., Proton bombardment of B-10, 16: 26248
TKALICH, V. S., Riemann waves, 16: 26436 (FTD-TT-62-354)
TOKAREVA, L. G., Radiation polymerization of vinyl monomer on fiber, 16: 25431
TOKAREVSKII, V. V., Proton spectra in stripping reactions, 16: 26356
TOKUOKA, S., Effects of radiation on glycolytic action, 16: 25234
TOLLER, M., Polarization of neutrons, 16: 25922 (NP-11977(p.49-52))
TOLLER, M., Radiative capture of μ mesons, 16: 25923 (NP-11977(p.53-4))
TOMABECHI, K., Accident analyses for fast assemblies, 16: 26565
TOMCZAK, Zenon, Radiation damage for study of properties of Ge, 16: 25849 (PAN-314/I-B)
TOMCZAK, Zenon, Thermoelectric power of Ge bombarded by fast neutrons, 16: 25852 (PAN-318/I-B)
TOMINAGA, T., Mixing particles using ribbon blender, 16: 25514 (NP-tr-889)
TOMITA, Y., Angular distributions of fast neutrons, 16: 26507
TOMLINSON, W. J., III., Nuclear isomer shift in Hg-195, 16: 26331
TOMOZAWA, Y., Spectral representation of two-point function, 16: 26057
TOMPKINS, F. C., Kinetics of oxidation of Li, 16: 25727
TONKS, Lewi, Control means for reactors, 16: 26576
TONOLINI, F., Emission in (p,α) and (d,α) reactions, 16: 26309
TONOLINI, F., Measurements of neutron beams, 16: 25589
TONOLINI, F., (n,α) Reactions in heavy elements, 16: 26297
TOPCHIEV, A. V., Radiation polymerization and copolymerization of allylhydrosilanes, 16: 25459
TOPPEL, B. J., Coupled fast-thermal steam superheating reactor, 16: 26553
TORNAU, Ruediger, Moisture in brown coal, 16: 25296
TOSCHI, A., Ecological conditions in area of Ispra, 16: 25166 (CNI-54)
TOUSCHEK, B., Storage ring for electrons and positrons (Adone), 16: 25930 (NP-11977(p.80-8))
TOUTENHOOFD, W., Specific heat of Gd sulfates, 16: 25367
TOWLE, J. H., Neutron inelastic scattering by Na-23, 16: 26508
TOWNDROW, E., Fluidization applied to thermostatic bath, 16: 25513 (NP-tr-888)
TOWNES, B. M., Pion-nucleon coupling constant, 16: 26105
TOWNLEY, Charles W., Determination of short-lived fission-product gases, 16: 25295
TOWNS, R. L., Nuclear heating in reactor, 16: 26502
TOYODA, K. G., Heavy water losses in PRTR, 16: 26616 (HW-73755)
TRAVINA, N. T., Phases in Ni–Be and Cu–Be, 16: 25810
TREACY, P. B., Deuterons elastically scattered from C, 16: 26338
TREFILOV, V. I., Formation of ω phase in Ti alloys, 16: 25830
TREIBER, Arno, Aromatic complexes of metals. LIX. 16: 25370
TRILLING, George H., Form factors in $K_{\mu 3}$ and K_{e3} decay, 16: 26135
TRIPP, Robert D., Measurement of Σ^- asymmetry parameter, 16: 26149 (UCRL-10238)
TRKA, Z., Properties of π^- mesons, 16: 26081 (JINR-P-974)
TROND, S. S., Hexafluorides of Mo, W, and U. I., 16: 25339 (GAT-T-969)
TROSTIN, S. S., Obtaining intense beam of polarized thermal neutrons, 16: 26198 (NP-11859)
TROUBLE, M., Detection of Pu, 16: 25277 (AEC-tr-5251)
TRUELL, Rohn, Properties of solids by ultrasonic methods, 16: 25547 (AROD-2302.8)
TRUESDALE, Richard S., Properties of intermetallic compounds, 16: 25748 (ASD-TDR-62-476)
TRUSWELL, A. E., Irradiation experiments with PuO_2 and $ThO_2 \cdot UO_2$, 16: 26483 (TID-7622(p.263-81))
TSETLIN, B. L., Radiation polymerization of vinyl monomer on fiber, 16: 25431
TSIEN, K. C., Production and properties of high-energy electrons, 16: 25188
TSUJI, Hiroyuki, Synthesis of elements, 16: 26341
TSUKADA, K., Angular distributions of fast neutrons, 16: 26507
TSUKERMAN, I. S., Photoproduction of charged vector meson pairs in Coulomb field, 16: 26362
TS'U-MO, Ch'en, Unobserved region in photoproduction dispersion ratios, 16: 26073 (JINR-P-904)
TSVETKOV, Yu. D., Free radical reactions in irradiated polytetrafluoroethylene. III., 16: 25460
TSYGANOV, E. N., High-energy proton-proton scattering, 16: 26179
TSYTOVICH, V. N., Cherenkov emission of charged particles, 16: 26098
TUBAEV, V. M., Electron capture by He ions, 16: 26021
TUCKER, P. A., Plutonium-bearing glass for reactor fuel, 16: 26478 (TID-7622(p.86-97))
TULLOS, E. J., Fluorine cell research facility, 16: 25314 (KY-399)
TURKIEWICZ, Jan, Apparatus for processing nuclear emulsions, 16: 25504 (PAN-293/I-A)
TURTON, C. Nigel, Isotopic exchange, 16: 25372
TURTON, Tatiana I., Isotopic exchange, 16: 25372
TUSOVA, A. M., Zirconium–Hf ratio in minerals and rocks, 16: 25631
TYAGUNOV, G. A., Focusing particles by magnetic field in linear electron accelerator, 16: 26380 (FTD-TT-61-242(p.33-6))
TYAGUNOV, G. A., Oscillations of particles in linear electron accelerator, 16: 26378 (FTD-TT-61-242(p.3-21))
TYAGUNOV, G. A., Trajectory of particles in linear electron accelerator, 16: 26379 (FTD-TT-61-242(p.22-32))
TYS, Yu., Transfer of neutrons in Al, Cu, and Ta bombardment, 16: 26221 (JINR-P-973)
TYZACK, C., Embrittlement of Nb in H contaminated NaK, 16: 25402

U

UCHIJIMA, T., Heat of formation of U_3O_7, 16: 25378
UCHIJIMA, T., Specific heat of U carbides, 16: 25379
UDAGAWA, Takeshi, Collective E3 and E4 transitions in spherical nuclei, 16: 26271
UDGAONKAR, Bhalchandra M., Model for decays of Σ and Λ hyperons, 16: 26131 (UCRL-9863)
UENO, Yoshio, Spatial distance in a curved space-time. II., 16: 26016
UHLER, R. L., Effects of chloramphenicol on cation absorption by plants, 16: 25139 (HW-72500(p.123-7))
UMANSKII (UMANSKIY), Ya. S., Hard compounds of refractory metals, 16: 25768 (NASA-TT-F-102)
UMARKHODZHAEV (UMARKHODZHAYEV), R. M., Nutation in experiments on nuclear magnetic resonance, 16: 25965 (JPRS-13656(p.260-78))
UNDERHILL, L. H., Critical size and reactivity calculations, 16: 26539
UNIK, J., Decay scheme of Es-254, 16: 26289
UNTERBERG, Walter, Temperature histories of internally heated thin bodies, 16: 25536
UNZ, H., Electromagnetic waves in longitudinally magnetized ferrites, 16: 26399 (AD-270635)
UPHAM, Harvey C., Changes across irradiated rat intestinal villi, 16: 25180

(TID-16271)
UPTON, A. C., Radiation-induced myeloid leukemias of RF mouse, 16: 25199
URIARTE, A., Systems of H_2SO_4 solutions of U and anionic resin, 16: 25330
URUNO, Shinobu, Acid leaching of Th carbide, 16: 25365
UYEKI, E. M., Effects of radiation on regenerating liver, 16: 25132 (HW-72500(p.92-6))

V

VACCA, G., Dose received after single absorption of fission product, 16: 25643 (CEA-2163)
VACHON, L. J., Protection of Be by anodic films, 16: 25724
VAHLDIEK, F. W., Growth and analysis of Al_2O_3 "whiskers," 16: 25694 (ASD-TDR-62-272)
VAL'DNER, O. A., Motion of electrons in magnetic system, 16: 26391 (FTD-TT-61-242(p.167-82))
VALDRE, U., Characteristics of C-14 source and versatile thickness gage, 16: 26108
VANDENBOSCH, S., Decay scheme of Es-254, 16: 26289
VANDENPLAS, P. E., Resonant behavior of plasma, 16: 26419
VANDERSLICE, Joseph T., Scattering of atoms, molecules, and ions, 16: 26041
VAN DE WALLE, Remy T., Form factors in $K_{\mu 3}$ and K_{e3} decay, 16: 26135
VAN-HIEU, Nguyen, Amplitudes of $K\bar{K} \rightarrow \pi\pi$ process and K_{e4} decay spectra, 16: 26083 (JINR-P-1000)
VAN HIEU, Nguyen, Angular distribution of decay products in $e^+ + e^- \rightarrow B^* + \bar{B}^-$ process, 16: 26185
VAN HIEU, Nguyen, Structure of vector current in weak interactions, 16: 26184
VAN-HIEW, Nguen, Amplitudes of π-meson production from neutrino by nucleon, 16: 26074 (JINR-P-905)
VAN HOVE, L., Pair distribution functions, 16: 26440
VAN KIEM, L. Khau, Detection of β-indolylacetic acid in plant cells, 16: 25103
VAN KRANENDONK, J., Crystal structure of solid H_2, 16: 25977
VAN REUTH, E. C., Specific heat of b.c.c. Ti–V alloys, 16: 25806
VAN R. SMIT, J., Cesium separation. III., 16: 25472 (AERE-R-4039)
VAN SANT, J. H., Thermal conductivity of graphite above 2000°F, 16: 25753 (GAMD-2089)
VAN'T HOF, J., Effects of x radiation on proliferating cells, 16: 25135 (HW-72500(p.104-8))
VAN VORIS, F. E., Niobium and carbon steel, 16: 25792
VARGO, E. J., Corrosion resistances of metallic materials to LiH, 16: 25718 (NP-11952)
VARLEY, J. H. O., F-center formation in alkali halides, 16: 25452
VASILEV, S. S., Proton absorption by Cu-63, 16: 26349
VASILEVSKAYA, D. P., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
VAUGHAN, G., Solution properties of polybutadiene, 16: 25363
VAUGHAN, George, Production of graft polymers, 16: 25871
VAVILOV, S. I., Newton's polygon and role in present mathematics, 16: 25692 (AEC-tr-5139)
VEDAM, R., Frequency response of ion chamber, 16: 25587
VEINBACHS, A., Thermodynamic properties of Zr–O, Ti–O, and Hf–O alloys, 16: 25384
VEKSLER, V. I., Production of ΛK^+ and $K^0\bar{K}^0$ pairs in $\pi^- p$ interactions, 16: 26068 (JINR-D-965)
VEKSLI, Z., Proton conductivity in $Li_2SO_4 \cdot H_2O$, 16: 25333
VENDRYES, G., Fast power reactors, 16: 26551
VENUTI, G. Campos, Capture of π^- mesons in complex nuclei, 16: 25902 (LNF-62/37(p.138-42))
VERA MEGE, R., Radioactivities of fluorites, 16: 25622
VERDIER, J., Electrocosvection effects on heat transfer, 16: 25533
VERGANELAKIS, A., Photoproduction of π^0 from polarized γ, 16: 25933 (NP-11977(p.94-6))
VERHAAR, B. J., Description of collective nuclear vibrations, 16: 26277
VERNON, H. C., Operating D_2O-moderated reactor, 16: 25496
VERONESI, P., Parity conservation pion production, 16: 25889 (LNF-62/37 (p.13-23))
VERONESI, P., Parity conservation in the reaction $\gamma + p \rightarrow \pi^+ + \pi^- + p$, 16: 25944 (NP-11977(p.127-9))
VERWEY, C. J., Radiochemical examination of errors in mine assaying, 16: 25635
VERYATIN, U. D., Chemistry and production of U fluoride compounds, 16: 25470
VICKLUND, H. I., Ion exchange in liquors from Utex ores, 16: 25466 (ACCO-43)
VIDEM, K., Description of I.F.A. corrosion loop, 16: 25715 (KR-14)
VILLA, F., Measurement of K^+ production cross sections, 16: 25894 (LNF-62/37(p.72-5))
VILLA, F., Polarization of Λ^0 in $\gamma + p \rightarrow K^+ + \Lambda^0$, 16: 25895 (LNF-62/37 (p.76-80))
VINH MAU, Nicole, Description of the O-16 spectrum, 16: 26303
VISWANATHAN, K. S., Many-electron wave equation, 16: 26003
VLASOV, A. V., Radiation polymerization of vinyl monomer on fiber, 16: 25431
VLATKOVIC, M., Neutron-irradiated Cl oxyanions, 16: 25444
VOEVODSKII, V. V., Free radical reactions in irradiated polytetrafluoroethylene. III., 16: 25460
VOGEL, Siegfried, Heating of materials by electron beams, 16: 26065 (AFCRL-975)
VOGLER, Seymour, Separating actinide and lanthanide metal values, 16: 25495
VOGT, Glenda S., Toxicity of Sr-90, Ra-226, and Pu-239, 16: 25119 (HW-72500(p.36-40))
VOICU, V., Preparation of I-131, 16: 25488
VOIGHT, A. F., Removal of Pu from U, 16: 25474 (IS-470)
VOLAVSEK, B., System UF_6–NH_4F, 16: 25469
VOLKOV, V. V., Transfer of neutrons in Al, Cu, and Ta bombardment, 16: 26221 (JINR-P-973)
VONDRA, B. L., Coatings for UO_2 and U particles, 16: 26479 (TID-7622 (p.98-107))
VON GUNTEN, H. R., Treatment of liquid waste at Würenlingen, 16: 26635 (EIR-24)
VON RUETHI, E., Treatment of liquid waste at Würenlingen, 16: 26635 (EIR-24)
VORONOV, N. M., Rate of vaporization of metallic oxides, 16: 25403
VOROS, T., Properties of transuranic elements, 16: 26217 (JINR-E-932)

W

WACHRAMEEFF, Artemy A., Concrete usage in reactor support, 16: 25781
WADDINGTON, F. B., Improved dielectrics produced by radiation, 16: 25426
WADDINGTON, F. B., Radiation resistance of organic insulating materials, 16: 25855
WADSWORTH, M. E., Transient electrode potentials of Ni, 16: 25322 (TID-16292)
WADSWORTH, Milton E., Oxygen solubility in water and thoria slurries, 16: 25324 (TID-16392)
WAECHTER, Karl Heinz, Moisture in brown coal, 16: 25296
WAHRHAFTIG, Austin L., Determination of appearance potentials, 16: 25320 (TID-16157)
WAIGHT, E. S., Polymerization of p-N,N-dimethylaminostyrene, 16: 25425
WALKER, P. L., Jr., Carbon, 16: 25774
WALKER, T. G., Nucleon-nucleon total cross sections, 16: 26145
WALKER, W. D., Experimental cross section for $\pi\pi \rightarrow K\bar{K}$, 16: 26146
WALL, Monroe E., Prog. rpt. on anti-radiation compounds, 16: 25249 (NP-11740)
WALSH, P. N., Thermodynamics of vaporization of rare earth oxides, 16: 25386
WALTER, A. J., Thermodynamic data for U oxides, 16: 25377
WALTERS, G. K., Nuclear polarization of He-3 gas, 16: 26332
WALTERS, Robert R., Isolation of I without carrier, 16: 25264 (ANL-6577)
WANGLER, T. P., Experimental cross section for $\pi\pi \rightarrow K\bar{K}$, 16: 26146
WANG-SENG, Li, On $T + T \rightarrow He^4 + 2n$ reaction, 16: 26075 (JINR-P-911)
WAPSTRA, A. H., Excited states of Ag-107, 16: 26280
WARD, W. V., Properties of Be sheet, 16: 25812
WARNER, L. B., Levels of Os-188, 16: 26286
WARREN, V. L., Determination of Mo–U ration in hexafluoride mixtures, 16: 25313 (K-1433)
WARSHAW, I., Family of rare earth compounds, 16: 25342

WARTON, Joseph W., Separation of rare earths, Y, and Sc, 16: 25280 (TID-15598)
WASSON, H. R., Response requirements for radiacs. III., 16: 25572 (USNRDL-TR-567)
WATABE, Mitsuo, Effect of Coulomb interaction on skin effect, 16: 26017
WATABE, N., Influence of P-32 on blood, 16: 25202
WATANABE, H., Acoustical magnons in magnetite, 16: 25979
WATANABE, Hironobu, Gamma dose rates in Japan, 16: 25675
WATANABE, Yoiti, Asymptotic behavior of adiabatic invariants, 16: 26422
WATERS, F. J., High-pressure Na generator designs, 16: 25502 (NAA-SR-Memo-6849)
WATSON, D. G., Chinook salmon spawning in the Columbia River, 16: 25144 (HW-72500(p.148-50))
WATSON, D. G., Radionuclides in Arctic plants and animals, 16: 25149 (HW-72500(p.165-9))
WATSON, J. S., Kinetics of uranyl sulfate exchange, 16: 25478 (ORNL-3296)
WATSON, Mason B., Measurement of Σ^- asymmetry parameter, 16: 26149 (UCRL-102381)
WATSON, W. W., Scattering of O ions from Ar and Xe, 16: 25990
WATT, D. A., Direct conversion of fission heat to electric power, 16: 25972
WATT, William, Carbon articles, 16: 25742
WATT, William, Manufacturing C articles, 16: 25743
WATTIER, J. B., Effects of radiation on elastomers and plastics, 16: 25843 (NARF-62-5T)
WEALE, J. W., Integral experiments on fast systems of Pu, U, and Th, 16: 26522
WEBB, M. S. W., Determination of Ba in bone ash, 16: 25286
WEBB, William A., Computer analysis of loss-of-coolant accident, 16: 26587 (CVNA-117(Vol.I))
WEBB, William A., Computer analysis of loss-of-coolant accident, 16: 26588 (CVNA-117(Vol.II))
WEBSTER, J. W., Reactivity coefficients, 16: 26543
WEEKS, C. C., Thermionic converters, 16: 26598 (NAA-SR-7144)
WEEKS, J. R., Liquid-metal fuel constitutions. IV., 16: 25815 (BNL-5156)
WEIGMANN, Hermann, Measurements of K conversion coefficients, 16: 26351
WEIL, L., Electroconvection effects on heat transfer, 16: 25533
WEINREICH, Marcel I., Apparatus for measuring electrical resistance, 16: 25769 (SCL-T-434)
WEINREICH, Marcel I., Separation of chemical elements, 16: 25278 (SCL-T-423)
WEINREICH, Marcel I., Treatment of subjects irradiated accidentally, 16: 25184 (SCL-T-424)
WEINSTEIN, D., Prog. rpt. on Zr alloys, 16: 25746 (ARF-2230-9)
WEISER, Russell S., Immunization of the A/Jax mouse, 16: 25108
WEISMAN, J., Prog. rpt. on neutron detector, 16: 25573 (WCAP-1989)
WELLER, W., Magnetic fluxes in superconductors, 16: 25982
WELLHOUSER, H. N., Maritime GCR land-based prototype, 16: 26592 (GAMD-1722)
WENDT, G., Gamma-gamma cascades of Dy-160, 16: 26346
WENSRICH, Carl, Bibliography on analyses of Pu and Pu alloys, 16: 25273 (UCRL-6873)
WENZEL, P., Production of electrical energy from radioactive isotopes, 16: 25667
WERLE, J., Polarized beams of pseudovector mesons, 16: 26124
WERNICK, J. H., Rare earth Laves phases, 16: 25798
WESTGARD, J., Decay of negative hyperon, 16: 26141
WESTRUM, E. F., Jr., Chemical thermodynamics of actinide element chalcogenides, 16: 25388
WETHERELL, A. M., High-energy peripheral and diffraction scattering, 16: 26159
WETHERELL, A. M., Nucleon-nucleon total cross sections, 16: 26145
WHALEN, J., Fission properties utilized in reactor design, 16: 26512
WHALEN, J. F., Parameters of neutrons in ZrH, 16: 26207
WHEATLEY, C. C. H., Direct conversion of fission heat to electric power, 16: 25972
WHEATON, E., Prog. rpt. on food irradiation, 16: 25172 (NP-11726)
WHITE, D., Thermodynamics of vaporization of rare earth oxides, 16: 25386
WHITE, P. A. F., Inert atmospheres, 16: 25517
WHITE, P. H., Value of η for U-238, 16: 26241
WHITE, R. E., Neutron-deuteron elastic scattering, 16: 26101
WHITEHEAD, Richard W., Chemical protection of irradiated mice, 16: 25252 (TID-16160)
WHITFIELD, W. J., Airborne contamination control, 16: 25509 (TID-16274)
WHITMARSH, C. L., Zircaloy properties relevant to reactor design, 16: 25760 (ORNL-3281)
WICHMAN, Sven H., Design of Al structure, 16: 25705 (BNL-4932)
WIDRIG, R. D., Heavy water losses in PRTR, 16: 26616 (HW-73755)
WIKTOR, S., Reaction $Al^{27}(d,He^3)Mg^{26}$, 16: 26313
WILCOX, William S., Surface tension of fused salts, 16: 26482 (TID-7622 (p.128-36))
WILDE, Frederick, Fuel elements for reactors, 16: 26573
WILDE, Ned, Generation of time distributed random pulses, 16: 25555 (IDO-16783)
WILDERMUTH, K., Beryllium-9 in cluster model, 16: 26272
WILHELMI, Zdzisław, Nuclear physics in Warsaw, 16: 25950 (PAN-279/I-A)
WILKS, R. S., Irradiation damage in Be and Mg oxides, 16: 25865
WILLARD, H. B., Polarization of β following P-32 decay, 16: 26259
WILLIAMS, D. E., Tantalum–Zr alloy system, 16: 25823 (IS-320)
WILLIAMS, D. N., Effect of Zr on Ti–Al, 16: 25820
WILLIAMS, Donald E., Crystal structure of bis(m-bromobenzoyl) methane, 16: 25262 (IS-295)
WILLIAMS, Robin O., Stored energy in Pb, Al, Ag, Ni, Fe, and Zr, 16: 25821
WILSON, E. Bright, Jr., Reliability of Hellmann-Feynman theorem, 16: 25970
WILSON, T. D., Bibliography on fuel cells, 16: 25915 (NP-11936)
WILSON, W. E., Prog. rpt. on organic liquid radiation stability, 16: 25429 (SRIA-62)
WINDWER, Stanley, Alkali metals in ethylenediamine, 16: 25357
WINKELMAN, James, Measuring radioactivity in gas chromatography effluents, 16: 25428
WINTERNITZ, P., Capture of polarized μ^- mesons by atomic nuclei, 16: 26236
WISE, S. S., Application of O_2- and F_2-bomb calorimetry to nuclear materials, 16: 25396
WISWALL, R. H., Jr., Fluorocarbons in reactor technology, 16: 26480 (TID-7622(p.109-20))
WISWALL, Richard H., Jr., Thermodynamics of solutions of actinides and fission products in Bi, 16: 25391
WITTELS, M. C., Radiation effects in U-doped zirconia, 16: 25861
WITTENBERG, L. J., Plutonium-bearing glass for reactor fuel, 16: 26478 (TID-7622(p.86-97))
WITZMANN, H., Aluminescence of Sr borate phosphors, 16: 25975
WITZMANN, H., Fluorescence of rare earths, 16: 25974
WOLF, Robert A., Superconductivity and superconducting electromagnets, 16: 25881 (ASD-TN-61-160)
WOLFSBERG, Max, Isotope effects on intermolecular interactions, 16: 25304 (BML-6050)
WONG, C., Isobaric states in nonmirror nuclei, 16: 26326 (UCRL-6733)
WONG, C., Isobaric states in medium-A nuclei, 16: 26333 (UCRL-6830)
WOO, L. F., Radiation effects on thoria–urania slurries, 16: 26494 (TID-7622(p.282-99))
WOOD, D. F., Analysis of Nb and Nb alloys, 16: 25294
WOOLLEY, Harold W., Thermodynamic properties of gases, 16: 25875 (AFSWC-TDR-62-21)
WORDINGHAM, M. L., Determination of Ba in bone ash, 16: 25286
WRIGHT, Kenneth A., Nuclear resonance scattering of bremsstrahlung, 16: 26275
WU, Tai-tsun, Perturbation theory of pion-pion interaction. II., 16: 26129
WULFF, J., Joining of refractory metals—W, 16: 25737 (WAL-TR-460.54/1-2)
WYMAN, L. L., Phases in Nb–Sn alloys, 16: 25791
WYSOPOLSKI, J., Latent image fading in film emulsions, 16: 25645 (CLRI-11)

X

XUONG, Nguyen-Huu, Multipion resonances in reaction $p+p \to 3\pi^+ + 3\pi^- + n\pi^0$, 16: 26233 (UCRL-10129)

Y

YADAVALLI, S. V., Dynamic friction of particle in plasma, 16: 26426
YAGAN, Raul, Estimation of liver size, 16: 25100
YAJIMA, Nobuo, Approach to multiple meson production, 16: 26170
YAKIMOV, G. V., Purifying water and sewage from radioactive isotopes, 16: 25677
YAKOVLEVA, M. K., Mechanism of radiation polymerization. II., 16: 25458
YAKOWITZ, H., Phases in Nb–Sn alloys, 16: 25791
YALCH, J. P., Program 20-8, for interpreting program 18-0, 16: 26466 (GEMP-123)
YAMADA, Y., Doubling radiation dose in genetics, 16: 25210
YAMAMOTO, G., Effect of x rays on metabolism of nucleic acid, 16: 25212
YAMAMOTO, G., Protection agents against radiation injury, 16: 25255
YAMAMOTO, Kunio, Moments in many-body problem, 16: 26173
YAMAMOTO, S. S., Decay of negative hyperon, 16: 26141
YAMAMOTO, Tadashi, Junior cave for chemical procedures, 16: 25260 (JAERI-1029)
YAMASAKI, Fumio, Gamma dose rates in Japan, 16: 25675
YAMASHITA, H., Changes of plasmin activity caused by radiation treatment, 16: 25161
YAMASHITA, H., Radiation cancer, 16: 25201
YAMAZAKI, Miwao, Pion-nucleon scattering, 16: 26174
YAMZIN, I. I., Small neutron diffractometer, 16: 25593
YANG, C. N., Neutrino reactions without boson production, 16: 26130
YANG, J. Y., ESR in tritium–polystyrene fluff system, 16: 25433
YANO, T., Mixing velocity in powder mixes, 16: 25512 (NP-tr-887)
YANO, T., Mixing particles using ribbon blender, 16: 25514 (NP-tr-889)
YANOVITSKII, E. G., Intensity of diffuse radiation emitted from turbid medium, 16: 26425
YASU, T., Radiation cancer, 16: 25201
YATES, James W., Prog. rpt. on materials, 16: 25744 (AD-269196)
YAVORSKY, P. M., Prog. rpt. on β radiation as hydrogenation catalyst, 16: 25414 (NYO-10184)
YIFTAH, S., Performance of fast reactors, 16: 26549
YOBLIN, J. A., Prog. rpt. on Be forging, 16: 25730 (ASD-TR-62-7-647)
YOKOMI, Hiroyuki, Approach to multiple meson production, 16: 26170
YOKO-O, Yoshimatsu, System of interacting Bose particles. I., 16: 26162
YOKO-O, Yoshimatsu, System of interacting Bose particles. II., 16: 26163
YOS, Jarrold M., Ultrasonic temperature determinations in plasma, 16: 26404 (RAD-TR-61-13)
YOSHIDA, T., Breakage of chromosomes by radiation. V., 16: 25209
YOSHII, G., Effects of x irradiation on blood pressure of rats, 16: 25222
YOSHIMOTO, H., Effects of leopon on radiation anemia, 16: 25159
YOUNG, Arthur P., Reactions between U oxide and bivalent metal oxides, 16: 25302 (BMI -1585)
YOUNG, J. A., Diffusion of charged particles in parabolic potential well, 16: 25885 (GEST-2002)
YUAN TS'AI, Te, Production of ΛK^0 and $K^0\bar{K}^0$ pairs in π^-p interactions, 16: 26068 (JINR-D-965)
YUKHNOVSKII, I. R., Spatial distribution of particles, 16: 26019
YUNG-CH'ANG, Wang, Production of ΛK^0 and $K^0\bar{K}^0$ pairs in π^-p interactions, 16: 26068 (JINR-D-965)
YURA, H. T., Theory of fundamental processes, 16: 26453
YURIN, V. A., Effects of γ rays on guanidinium Al sulfate, 16: 25456
YUTKIN, M. G., Recording neutron spectra of fast reactors, 16: 26204 (AEC-tr-5217)

Z

ZABOEV (ZABOYEV), A. I., Oscillations of electrons in betatron, 16: 26385 (FTD-TT-61-242(p.111-28))
ZACHARIASEN, F., Consequences of hypothesis of Regge poles, 16: 26128
ZALESKI, C. P., Fast power reactors, 16: 26551
ZALESKI, C. P., Neutron flux in equilibrium in natural U, 16: 26529
ZALESKI, C. P., Physical research on RAPSODIE, 16: 26569
Zaman, A-u
see A-u-Zaman
ZAMOLODCHIKOV, B. I., Annular phasatron with spiral magnetic field, 16: 26371 (JINR-P-930)
ZAPEVALOV, V. A., Splitting of giant resonance in nuclei, 16: 26357
ZAPLATIN, N. L., Annular phasatron with spiral magnetic field structure, 16: 26371 (JINR-P-930)
ZAPPA, L., Polarization of external bremsstrahlung, 16: 26106
ZATSEPIN, V. I., Lateral distribution of Cherenkov radiation from broad atmospheric showers, 16: 26062
ZAVATTARELLI, R., Results of wet steam cooling experiments, 16: 25530 (EURAEC-42)
ZEBROSKI, E. L., Plutonium fuel processing and fabrication, 16: 25697 (GEAP-3876)
ZEITLER, E., Photographic film-plate for measuring radiation, 16: 25574 (AEC-tr-5193)
ZELAZNY, R., Multi-group neutron transport theory, 16: 26538
ZELENKA, J., Influence of radiation on piezoelectric resonators, 16: 25857
ZELVINSKII, V. G., Quadrupole oscillations of spherical nuclei, 16: 26359
ZHELEZNIAKOV (ZHELEZNYAKOV), V. V., Instability of magnetoactive plasma, 16: 25960 (JPRS-13656(p.137-63))
ZHELUDEV, I. S., Effects of γ rays on guanidinium Al sulfate, 16: 25456
ZHIZHIN, E. D., Diffraction formation of particles at high energies, 16: 26089 (NP-11832)
ZICHICHI, A., Magnetic moment of the muon, 16: 26115
ZIMANYI, J., Circular polarization of γ quanta, 16: 26267
ZIMMERMANN, F., Air conditioning isotope laboratories, 16: 25676
ZIVANOVIC, Srbislav, Radar cross section of plasma bodies, 16: 26396 (AD-268824)
ZOMBKOVSKII, S. M., Elastic scattering of 7.2-Bev π^- mesons on protons, 16: 26180
ZOZULJA, A. P., Investigations of complex compounds in solutions, 16: 25368
ZUBAREV, P. V., Effect of radiation on heat strength of steel, 16: 25859
ZUMWALT, L. R., Fission product retention studies of graphite reactor fuels, 16: 26486 (TID-7622(p.171-92))
ZUMWALT, L. R., Release of K and Xe fission products from (U,Th) C_2–graphite fuel matrix, 16: 25752 (GA-3211)
ZWEIFACH, B. W., Histochemical and biological alterations following irradiation, 16: 25175 (TID-16051)
ZWEIFEL, P. F., Group cross sections for fast reactors, 16: 26519
ZWICKER, U., Investigations on Cu–Zr alloys. I., 16: 25794

SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries. A more complete description of the patterns and style of indexing used is included in the introductions to the subject index cumulations that are issued quarterly.

As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

A

ABSTRACTS
of papers presented at AWS 43rd Annual Meeting and ASME Metals Engineering Conference, 16: 25741
ACCELERATORS
characteristics of Adone, 16: 25906 (LNF-62/37(p.166-79))
design and development, 16: 25916 (NP-11977)
development in Japan, 16: 25084 (JAERI-7020)
operation of Florida State University Tandem, 16: 25910(R) (NP-11749)
research programs, 16: 25886 (LNF-62/37)
research programs, 16: 25916 (NP-11977)
storage ring construction for electrons and positrons, 16: 25905 (LNF-62/37(p.161-5))
ACETALDEHYDE
radioinduced polymerization in condensed phase, x-ray, 16: 25461
ACETIC ACID
radiolysis, hydrogen yields in, 16: 25419(R) (RRL-84)
ACETIC ACID, [(CARBOXYMETHYLIMINO)BIS(ETHYLENENITRILO)] TETRA-
effectiveness in removal of internally-deposited plutonium, 16: 25128(R) (HW-72500(p.77-80))
ACETIC ACID, (ETHYLENEDIAMINE)TETRA- COMPLEXES
properties of rare earth, 16: 25337 (IS-297)
ACETIC ACID, (TRIETHYLENETETRAAMINE)HEXA-
effectiveness in removal of internally-deposited plutonium, 16: 25128(R) (HW-72500(p.77-80))
ACETONE
heat transfer in boiling, electroconvection effects on, 16: 25533
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354
ACETONE, THENOYLTRIFLUORO-
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
ACETYLENE
fragmentation, comparison of theory and experiment, 16: 25877(R) (ANL-6534)
ACRYLIC ACID, ALKALI METAL SALTS
radioinduced polymerization and polymer crosslinking, 16: 25446
ACRYLONITRILES
radioinduced copolymerization to allylsilanes, 16: 25459
radioinduced polymerization to caproic acid-amide fiber, 16: 25431
ACTINIDE COMPOUNDS
thermodynamic properties, 16: 25398
ACTINIDE OXIDES
thermodynamic properties, 16: 25388
ACTINIDES
separation from lanthanides by solvent extraction, 16: 25495(P)
ACTINIUM ISOTOPES Ac-225
production in neon and nitrogen ion reactions with thorium-232 and uranium-238, 16: 25411 (JINR-P-978)
ACTINIUM ISOTOPES Ac-226
production in neon and nitrogen ion reactions with thorium-232 and uranium-238, 16: 25411 (JINR-P-978)
ACTIVATION ANALYSIS
use in determining rare earths in meteorites, 16: 25648(R) (GA-2782 (Rev.))
ADENINE
therapeutic use for anemia during radiotherapy of malignant tumors, 16: 25159
ADHESIVES
development of high-temperature, 16: 25699(R) (NP-11815)
ADRENALINE
metabolism in prenatally irradiated rabbits, 16: 25244
ADRENOCHROME
protective effects against injuries during radiotherapy of postoperative breast cancer, 16: 25256
ADVANCED EPITHERMAL THORIUM REACTOR
design and characteristics of, 16: 26568
integral-reactor-physics experiments, neutron cross sections at 10^3 to 10^7 ev, 16: 26525
AEROSOLS
composition of stratospheric, 16: 25609 (AFCRL-62-299)
diffusion over 16-mile range, procedures for Green Glow studies at Hanford, 16: 25612 (HW-71400(Vol.I))
AGE ESTIMATION
formulas for lead/uranium method, 16: 25626
AIR
analysis for radioactivity on Zugspitzplatt (2580 m NN) August 15 to September 21, 1955, 16: 25625
electron energy distributions in weakly ionized, 16: 25989
fall-out monitoring, Canada, Jan.–March 1962, 16: 25616(R) (NP-11914)
monitoring equipment for continuous use, 16: 25542 (AEEW-R-150)
neutron flux at interface with ground, Monte Carlo calculation of, 16: 26200 (ORNL-3287)
plutonium content in ground, 1959, 16: 25171
sampling equipment, 16: 25542 (AEEW-R-150)
second virial coefficients and their derivatives for constituent pairs involving neutral species at high temperatures, 16: 25875 (AFSWC-TDR-62-21)
thermal characteristics in graphite channels, 16: 25534 (BNL-5522)
thermodynamic properties at high temperatures, review, 16: 25300 (ARL-62-358)
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)

AIRCRAFT EQUIPMENT
thermal radiation effects, 16: 25876(R) (AFSWP-844)
AIRCRAFT REACTORS
control element mechanisms, development summary for P122C, 16: 26457 (APEX-729)
ALASKA
fall-out monitoring, 1960, 16: 25149(R) (HW-72500(p.165-9))
ALBUMINS
radioinduced reduction in rabbit serum, protective effects of orotic acid on, 16: 25257
ALCOHOLS
solvent properties for salicylatoberyllium complexes, 16: 25486
ALKALI METAL HALIDE CRYSTALS
radioinduced F-center formation in, 16: 25452 (AERE-R-3842)
ALKALI METALS
corrosive effects on containment alloys and metals at high temperatures, review, 16: 25714 (DMIC-169)
effects on solubility of uranium in bismuth, 16: 25815 (BNL-5156)
electric conductivities and electron spin resonance and optical absorption spectra in ethylenediamine, 16: 25357
ALPHA DECAY
probabilities of, pairing correlation effects on absolute, 16: 26308
ALPHA PARTICLES
detection and measurement at 700°C, development of miniature silicon carbide neutron detectors for, 16: 25573(R) (WCAP-1989)
detection and measurement using superconducting-film detector, 16: 25590
detection in air, 16: 25542 (AEEW-R-150)
interactions, cluster-model effective potentials for, 16: 26171
ALPHA SOURCES
survey, 16: 25271(R) (TID-16156)
ALPS MOUNTAINS (EUROPE)
uranium mineralization in, 16: 25634 (CNEN-53)
ALUMINUM
analysis of pure and superpure, activation, 16: 25288
bonding to nickel-plated uranium, metallographic studies, 16: 25817
corrosion and film formation in heat transfer to water, 16: 26467(R) (HW-73100)
deformation, stored energy increase and release after, 16: 25821
deterioration in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
effects on corrosion resistance of iron and steels, 16: 25721(T) (FTD-TT-61-31(p.60-9))
electric conductivity at 4.2 and 20.4°K, 16: 25775
electric conductivity of, at low temperatures, 16: 25777 (UCRL-6480)
fabrication of, for support of 60-ton critical assembly, 16: 25705 (BNL-4932)
fracture under impulsive loading, 16: 25759 (NP-11890)
heat of adsorption on mica and sodium chloride, 16: 26009
heat transfer and pressure drop in eccentric tubes, 16: 25526 (NYO-9649)
neutron capture cross sections, 16: 26509
neutron scattering at 3.4 to 4.6 Mev, angular distributions, 16: 26507
nitrogen-14 and -15 reactions, neutron transfer in, 16: 26221 (JINR-P-973)
properties, theory of infrared and optical, 16: 25758 (NP-11675)
separation from beryllium by solvent extraction using phosphate esters, 16: 25475 (NCL/AE-172)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
ALUMINUM ALLOYS
analysis, activation, 16: 25288
fracture under impulsive loading, 16: 25759 (NP-11890)
ALUMINUM–BORON–COBALT SYSTEMS
phase studies, 16: 25793
ALUMINUM–CHROMIUM–IRON ALLOYS
development and testing of, for use as resistance strain gages at 1600°F, 16: 25559 (NAMC-ASL-1050(Pt.II))
ALUMINUM COATINGS
protective effects against corrosion of thorium and uranium during long-term storage, 16: 25713 (BMI-1563)
ALUMINUM–COBALT–DYSPROSIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM CRYSTALS
neutron double Bragg scattering by single, angular distributions, 16: 26211
ALUMINUM–DYSPROSIUM–GADOLINIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–DYSPROSIUM–IRON ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–DYSPROSIUM–MANGANESE ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–DYSPROSIUM–NICKEL ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–DYSPROSIUM–TERBIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–ERBIUM–GADOLINIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM FOILS
optical emission of irradiated, 16: 25847 (ORNL-3114)
ALUMINUM–GADOLINIUM–NEODYMIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–GADOLINIUM–PRASEODYMIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–HOLMIUM–MANGANESE ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–IRON ALLOYS
fragility of solid solution, 16: 25776
ALUMINUM–IRON–URANIUM ALLOYS
development for use as fuel elements, 16: 25735(R) (NMI-7251)
ALUMINUM ISOTOPES Al-27
deuteron reactions (d, helium-3) at 12.8 Mev, angular distributions and magnesium-26 energy levels from, 16: 26313
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
neutron activation cross sections at 14.7 Mev, 16: 26268
proton reactions (p,α) at 9.7 to 14.5 Mev, angular distributions and cross sections for, 16: 26309
proton reactions (p,pn) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
proton reactions (p,pn$^+$) at 130 to 660 Mev, 16: 26354
ALUMINUM ISOTOPES Al-28
energy levels, 16: 26306
half life, 16: 26213 (AE-78)
ALUMINUM–MANGANESE–TERBIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–MOLYBDENUM–TIN–ZIRCONIUM ALLOYS
fatigue, effects of applied stress and hydrogen sorption on static, 16: 25746(R) (ARF-2230-9)
ALUMINUM–NEODYMIUM–TERBIUM ALLOYS
phase studies, Laves, 16: 25798
ALUMINUM–NICKEL ALLOYS
deformation and second-phase particles in, 16: 25693 (ARL-62-357)
ALUMINUM OXIDE COATINGS
oxidation effects on uranium(IV) oxide particles, 16: 25749 (BMI-1586)
preparation and properties, 16: 26476 (TID-7622(p.57-73))
ALUMINUM OXIDE CRYSTALS
diffusion of xenon-133 in alpha-, 16: 26491 (TID-7622(p.245-53))
growth and properties of whiskers at 1700 to 1800°C, 16: 25694 (ASD-TDR-62-272)
ALUMINUM OXIDES
properties as desiccant for purifying carbon dioxide, 16: 25299 (AAEC/E-86)
reactions with sodium vapor at 940°C, 16: 25318 (RAD-TM-60-44)
ALUMINUM PHOSPHATES
properties as strain gage cement at 1600°F, 16: 25560 (NAMC-ASL-1050 (Pt.III))
ALUMINUM–PLUTONIUM ALLOYS
heats of formation, 16: 25834
reactivity in fuel systems, temperature effects, 16: 26467(R) (HW-73100)
ALUMINUM–TITANIUM ALLOYS
creep and tensile properties, effects of hafnium and zirconium, 16: 25820
ALUMINUM–TITANIUM–ZIRCONIUM ALLOYS
tensile properties, effects of niobium and tantalum, 16: 25813
ALUMINUM–YTTRIUM ALLOYS
phase equilibria in, 16: 25814

AMERICIUM
separation from transcurium elements by solvent extraction using 2-ethylhexylphenylphosphonic acid, 16: 25477 (ORNL-3273)
AMERICIUM ISOTOPES Am-241
neutron fission cross section, 16: 26505 (TID-13546)
transfer from plasma to milk, 16: 25121(R) (HW-72500(p.44-9))
AMERICIUM ISOTOPES Am-243
neutron fission cross section, 16: 26505 (TID-13546)
neutron fission cross sections at 0.03 to 1.8 Mev, 16: 26512
AMINES
formation and physiological effects, 16: 25176(R) (TID-16113)
formation and physiological effects, 16: 25250(R) (NP-11753)
solvent properties of primary, for beryllium in fluoride solutions, 16: 25475 (NCL/AE-172)
AMMONIA
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
use in preparation of oxonides, 16: 25338
AMMONIUM CHLORIDES
potentials of nickel electrode in, 16: 25322 (TID-16292)
AMMONIUM FLUORIDES
reactions with uranium hexafluoride, 16: 25469
AMMONIUM SULFATES
potentials of nickel electrode in, 16: 25322 (TID-16292)
AMMONIUM URANIUM FLUORIDES
preparation and crystal structure, 16: 25469
AMPLIFIERS
development of pneumatic, in USSR, 16: 25567 (NP-11947)
ANALYSIS
methods for microscopic, review, 16: 25275(T) (AEC-tr-5194)
ANEMIA
radioinduced, biochemical changes in, 16: 25226
radioinduced, effects on development, growth, and sensitivity of Yoshida ascites sarcomas, 16: 25221
radioinduced in rabbits, protective effects of orotic acid on, 16: 25257
therapy with leopon in patients during radiotherapy of malignant tumors, 16: 25159
ANIMALS
cesium metabolism, 16: 25157
plutonium distribution from fallout, 16: 25171
therapy with ultrasonics, 16: 25219
ANION EXCHANGE MATERIALS
diffusion coefficients of neptunium(IV) and plutonium(IV) ions in, 16: 25309 (DP-727)
equilibrium of XX resin with uranyl sulfates, 16: 25330
uranyl sulfate exchange with, 16: 25478 (ORNL-3296)
ANIONS
photodetachment, 16: 26028
ANISOLE
drop coalescence at planar interface with water, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
ANTIBIOTICS
synergistic action of actinomycin D and x radiation on cell growth in tissue cultures, 16: 25232
ANTIBODIES
formation, radiosensitivity, 16: 25109
production in tissue homogenates, effects of rapid thawing of frozen cells, 16: 25096(R) (TID-15980)
ANTIGENS
preparation of urinary cancer, 16: 25251(R) (TID-16159)
ANTIMONY
determination in gallium arsenides by neutron activation, 16: 25293
neutron capture cross sections, 16: 26509
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
ANTIMONY ISOTOPES Sb-121
deuteron reactions (d,2n) at 9 to 28 Mev, tellurium yield ratios from, 16: 26240
neutron capture cross sections at 10^3 to 10^8 ev, 16: 26518
ANTIMONY ISOTOPES Sb-123
neutron capture cross sections at 10^3 to 10^8 ev, 16: 26518
ANTIMONY ISOTOPES Sb-124
determination as contaminant in phosphorus-32 humic preparation, spectrometric, 16: 25448
ANTIMONY ISOTOPES Sb-127
radiochemical studies, 16: 25442
ANTIMONY ISOTOPES Sb-128
radiochemical studies, 16: 25442
ANTIMONY ISOTOPES Sb-129
radiochemical studies, 16: 25442
ANTIMONY ISOTOPES Sb-130
radiochemical studies, 16: 25442
ANTINEUTRINOS
interactions with nucleons at high energies, boson nonproduction in, 16: 26130
production in meson (π) decay, properties, 16: 26147
reactions with nuclei at high energies, boson nonproduction in, 16: 26130
ANTINUCLEONS
interactions with nucleons at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions with hyperons (Λ) and nucleons, dispersion relations, 16: 26110
ANTIPROTONS
annihilation on protons, proton complex form factors from, 16: 26112
interactions at rest, bubble chamber study, 16: 25926 (NP-11977 (p.64-5))
interactions with protons at rest, neutral-particle production and quantum numbers from, 16: 26121
interactions with protons, ω-N coupling constant from, 16: 26175
interactions with protons, meson production at 1.67 Bev, 16: 26233 (UCRL-10129)
ARGON
absorption spectrum, K resonance structure in, 16: 25873 (AFOSR-1732)
isotopic composition in iron meteorites, 16: 25614 (JPL-TR-32-147)
oxygen ion elastic scattering at 153 Mev, 16: 25990
reactions with helium ions at 300 to 1500 kev, electron loss in, 16: 26021
reactions with helium, ionization cross sections, 16: 26238
stopping power for recoil ions from alpha reactions (α,n), 16: 26243
thermodynamic properties at high temperatures, review, 16: 25300 (ARL-62-358)
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
ARGON ISOTOPES Ar-40
proton reactions (p,n) at 17 Mev, effects of excited isobaric states, 16: 26333 (UCRL-6830)
ARMY REACTORS (SL-1)
accident and safety report, 1961, 16: 25652(R) (IDO-12021)
ARMY REACTORS (SM-1)
coolant fission product activity, 16: 26490 (TID-7622(p.236-42))
Core III thermal analysis, 16: 26583 (APAE-105(Suppl.1))
environs monitoring, summary for period 1½ yrs prior to startup to 3 yrs after, 16: 25646(R) (ERDL-1691-TR)
ARSENATES
uptake by plants, effects of soil composition, tracer study, 16: 25138(R) (HW-72500(p.119-22))
ARSENIC
reactions with benzene solutions following neutron irradiation, 16: 25441
ARSENIC CHLORIDES
reactions with benzene following neutron irradiation, 16: 25441
ARSENIC COMPOUNDS
phenyl-, reactions with benzene solutions following neutron irradiation, 16: 25441
ARSENIC ISOTOPES As-74
decay scheme, 16: 26283
ARSINE, TRIPHENYL-
reactions with benzene following neutron irradiation, 16: 25441
ARSONIC ACIDS
phenyl-, reactions with benzene solutions following neutron irradiation, 16: 25441
ASPHALT
thermal radiation effects, 16: 25876(R) (AFSWP-844)
ASTATINE ISOTOPES
production ratios in proton and deuteron reactions with bismuth and lead, 16: 26220 (JINR-P-950)
ASTROPHYSICS

magnetohydrodynamics in, cosmic, 16: 26051
spectral forbidden transitions in, 16: 26025
ATMOSPHERE
analysis for tritium, in northern Europe, 1957 to 1962, 16: 25619(R) (TID-16272)
electromagnetic properties, effects of atomic explosions at Novaja Zemlja, Sept. 10 to Nov. 4, 1961, 16: 25086 (KGO-611)
fall-out monitoring in Cracow, Jan. through Mar. 1960, 16: 25620
monitoring for radioactivity at Paducah Plant, 1961, 16: 25653 (KY-419)
wind profile in lowest 400 feet, 16: 25611 (BNL-718)
ATMOSPHERES
production and uses of inert, for nuclear technology, 16: 25517
properties of lunar and planetary, 16: 25094
properties of lunar, 16: 26049
ATOMIC BEAMS
ionization with plasma ion source, 16: 26020
reactions with gases at high energies, forces in, 16: 26041
reactions with gases above 0.2 kev, electron capture and loss in, 16: 26043
ATOMIC ENERGY
insurance in field of, review, 16: 25666
research program in Japan, 16: 25085 (JAERI-7022)
ATOMIC EXPLOSIONS
atmosphere effects, observations at Kiruna Geophysical Observatory, Sept. 10 to Nov. 4, 1961, 16: 25086 (KGO-611)
blast and radiation effects on ordnance material, 16: 25088 (PA-TR-1690)
crater formation by, 16: 25503 (NP-11816)
detection of underground, development of digitization system for seismic records for, 16: 25610 (AFCRL-863)
thermal radiation from, equipment for simulation, 16: 25090
ATOMIC PHYSICS
electron correlation and Hartree-Fock energies of 1s2s ^1S and ^3S states, 16: 26004
electron correlation and Hartree-Fock energies in 2-electron atoms, 16: 26005
energy levels of N-particle quantum systems in, 16: 26441
representations of systems of dipoles and ions, classical theory, 16: 26019
ATOMS
book: *Atomic and Molecular Processes*, 16: 26024
charge densities, reliability of Hellmann-Feynman theorem for approximate, 16: 25970
charged particle reactions with, energy transfers in, 16: 26039
electromagnetic-wave gradient effects on, 16: 26183
electron binding by, coefficients and cross sections for, 16: 26030
electron correlation and Hartree-Fock energies for 2-electron, 16: 26005
electron elastic scattering, 16: 26033
electron reactions, excitation and ionization cross sections for, 16: 26036
electron reactions, excitation and ionization from, 16: 26035
electron scattering at 10 to 80 kev, differential cross sections and excitation of bound states in, 16: 26237
gamma recoilless resonant absorption by impurity, in host crystals, 16: 26316
neutron scattering and thermalization by, models for, 16: 26209 (BNL-5821)
photoionization, 16: 26027
properties at high temperatures and velocities, 16: 26029
reactions in systems of, theory for, 16: 26038
reactions with atoms and molecules, ionization in, 16: 26042
reactions with ions, excitation and ionization cross sections for, 16: 26036
reactions with ions, charge transfer and electron detachment in, 16: 26042
spectra, allowed transitions and probabilities for, 16: 26026
spectra, forbidden transitions in, 16: 26025
AURORAL STORMS
detection of rays with east-west speeds of 13 to 30 km/sec, 16: 26060
emission of 10830 Å helium line from sunlit, 16: 26002
AUXINS
deposition of β-indolylacetic acid in plant cells and tissues, tracer study, 16: 25103

B

BACTERIA
radiation effects on glucose and pyruvic acid oxidation in, effects of cysteine on, 16: 25223
radiosensitivity of spores of *Clostridium botulinum*, effects of strain and food substrate, 16: 25172(R) (NP-11726)
sulfate metabolism, effects of molybdate, 16: 25151(R) (TID-16073)
BARIUM
determination in bone ash, spectrographic, 16: 25286
determination, micro-coulometric, 16: 25285
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
effects on wetting of cobalt, iron, and nickel by liquid sodium, 16: 25782
evaporation from cathodes, thermionic, 16: 25544(R) (AFCRL-62-2)
BARIUM CARBONATES
analysis for carbon dioxides, microdiffusion, 16: 25291
BARIUM ISOTOPES Ba-135
neutron reactions, gamma spectra from, 16: 26254
BARIUM ISOTOPES Ba-139
determination in fission gases, spectrometric, 16: 25295
BARIUM ISOTOPES Ba-140
determination in fission gases, spectrometric, 16: 25295
BARIUM OXIDES
evaporation from nickel and platinum cathodes, thermionic, 16: 25544(R) (AFCRL-62-2)
BEACHES
sand drift on Thyborn Inlet, Denmark, tracer study, 16: 25641
BEHAVIOR
of pigeons, effects of inhaled mercury vapor, 16: 25154 (UR-578)
BENZENE
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
drop coalescence at planar interface with ethylene glycol, hydro-dynamic mechanism for, 16: 25956 (UCRL-10097)
excited states in, radiationless transitions and radiative lifetime of $^3B_{1u}$, 16: 25436
fragmentation, comparison of theory and experiment, 16: 25877(R) (ANL-6534)
heat transfer in boiling, electroconvection effects on, 16: 25533
potentials of nickel electrode in, 16: 25322 (TID-16292)
reactions with arsenic compounds following neutron irradiation, 16: 25441
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
BENZENE, CHLORO-
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
BENZENE, DICHLORO-
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
BENZENE, ETHYL-
radiation effects of beta particles and recoil carbon-14 in, 16: 25438
BENZENE, HEXACHLORO-
properties as sensitizer for radioinduced crosslinking of paraffins and polyethylene, 16: 25455
BENZENE, NITRO-
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
BENZENE–WATER SYSTEMS
drop coalescence at planar interfaces in, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
BENZOPHENONES
properties as sensitizer for radioinduced crosslinking of paraffins and polyethylene, 16: 25455
BERKELIUM
separation from americium and curium by solvent extraction using 2-ethylhexylphenylphosphonic acid, 16: 25477 (ORNL-3273)

BERYLLIUM
analysis for potassium and sodium, flame photometric, 16: 25274 (Y-1394)
content in granites, age estimation from, 16: 25630
corrosion by carbon dioxide, effects of anodic film, 16: 25724
crystal structure, behavior of inclusions in, 16: 25784
diffusion and solubility of hydrogen, nitrogen, and oxygen in, 16: 25757(R) (NMI-9815)
forging hot-pressed, effects on mechanical properties, 16: 25730(R) (ASD-TR-62-7-647)
mechanical properties of sheet, effects of surface finish, 16: 25812
oxidation in carbon dioxide and oxygen with and without water vapor above 500°C, 16: 25725
purification by solvent extraction, 16: 26481 (TID-7622(p.122-7))
reactions with uranium dioxide, effects of anodic film, 16: 25724
separation from fluoride and sulfate solutions by solvent extraction using phosphate esters, 16: 25475 (NCL/AE-172)
BERYLLIUM ALLOYS
oxidation in moist atmospheres at 1000 to 1800°F, 16: 25723
BERYLLIUM COMPLEXES
separation of salicylato- from aqueous solutions by solvent extraction with aliphatic alcohols, 16: 25486
BERYLLIUM–COPPER ALLOYS
fracture under impulsive loading, 16: 25759 (NP-11890)
phase studies, 16: 25810
BERYLLIUM IONS
electron correlation and Hartree-Fock energies of 1s2s ^1S and ^3S states, 16: 26004
BERYLLIUM ISOTOPES Be-8
fission, analysis by (p,α) reactions on lithium-7, 16: 26262
BERYLLIUM ISOTOPES Be-9
energy levels in the cluster model, 16: 26272
proton reactions (p,γ), excited states of boron-10 from, 16: 26266
proton reactions (p,γ) at 850 to 1110 kev, 16: 26281
BERYLLIUM–NICKEL ALLOYS
phase studies, 16: 25810
BERYLLIUM–NIOBIUM ALLOYS
properties of $NbBe_{12}$, Nb_2Be_{17}, and Nb_3Be_{13}, effects of fabrication and processing on, 16: 25748 (ASD-TDR-62-476)
BERYLLIUM OXIDE COATINGS
preparation and properties, 16: 26476 (TID-7622(p.57-73))
BERYLLIUM OXIDE COMPACTS
fabrication, 16: 25734 (NAA-SR-7293)
BERYLLIUM OXIDE–MAGNESIUM OXIDE COMPACTS
fabrication, 16: 25734 (NAA-SR-7293)
BERYLLIUM OXIDE–SAMARIUM OXIDE SYSTEMS
fabrication, 16: 25734 (NAA-SR-7293)
BERYLLIUM OXIDES
bonding to pyrolytic graphite, development of brazing alloys and methods for, 16: 25739
crystal structure in occurrence with mineral Swedenborgit, 16: 25770(T) (UCRL-Trans-826(L))
crystal structure in hot-extruded, 16: 25789
density and lattice parameters, determination by x-ray patterns, 16: 25783 (AERE-R-3774)
preparation of high-purity, 16: 26481 (TID-7622(p.122-7))
radiation effects on defect clusters in, 16: 25865
radiation effects on helium generation and release by, method for measuring, 16: 26492 (TID-7622(p.254-62))
reactions with sodium vapor at 940°C, 16: 25318 (RAD-TM-60-44)
BERYLLIUM POWDERS
density and electric resistivity of sintered, effects of particle size, 16: 25780
BERYLLIUM–TANTALUM ALLOYS
properties of Ta_2Be_{17}, effects of fabrication techniques and processing variables on, 16: 25748 (ASD-TDR-62-476)
BERYLLIUM–ZIRCONIUM ALLOYS
properties of Zr_2Be_{17}, effects of fabrication techniques and processing variables on, 16: 25748 (ASD-TDR-62-476)
BERYLS
crystal chemistry, 16: 25628
BETA PARTICLES
content in plants, 16: 25644 (CLOR-9)
detection in air, 16: 25542 (AEEW-R-150)
dosimetry using Soup Bowl rate meter, 16: 25650 (HW-52448)
effects of injected, on bone blood and lymph in rabbits, 16: 25202
BETA SOURCES
evaluation as hydrogenation catalyst in coal processing, 16: 25414(R) (NYO-10184)
properties of carbon-14, 16: 26108
BETATRONS
design and testing, 16: 26376(T) (FTD-TT-61-242)
electron acceleration, capture theory, 16: 26384(T) (FTD-TT-61-242 (p.54-110))
electron injection, capture and oscillations during, 16: 26385(T) (FTD-TT-61-242(p.111-28))
motion of particles in, accuracy of expressions for, 16: 26386(T) (FTD-TT-61-242(p.129-33))
BIBLIOGRAPHIES
on analytical procedures for radioisotopes in urine, 16: 25268 (JAERI-4020)
on chemical analysis of plutonium and its alloys, 16: 25273 (UCRL-6873)
on food preservation by irradiation, 16: 25685 (SB-403(Rev.))
on fuel cell, 16: 25915 (NP-11936)
on gamma radiography, 16: 25604 (BNL-716)
on hard compounds of refractory metals, 16: 25768(T) (NASA-TT-F-102)
on hard, high-melting borides, carbides, nitrides, and silicides, 16: 25835
on heat and mass transfer with phase and chemical conversions, 16: 25527 (RM-2852-PR)
on hot laboratories, 16: 25500 (KFK-69)
on investigations of complex compounds in solutions, 16: 25368
on isotopic substitutions in water, 1950 to 1961, 16: 25307 (CEA-Bib-19)
on liquid metal boiling, 16: 25522 (ASD-TR-61-594)
on packaging requirements for radiosterilized foods, 16: 25681 (TID-15144)
on radiation effects on semiconductor devices, 16: 25842 (LAMS-2706)
on radiation effects, accessions at REIC, 16: 25844 (NP-11656)
on radiation effects on coaxial cables and insulation, 16: 25846 (NP-11929)
on radiation effects on central nervous system, 16: 25235
on radiation effects on nervous system in animals exposed during embryo genesis, 16: 25236
on radioactive fall-out, 16: 25617 (TID-3086(Suppl.1))
on reactor fuel processing and waste disposal, 16: 25476 (ORNL-2971 (Vol.4))
on seismology, Soviet literature, 1958, 1959, and 1960, 16: 25608 (AD-265437)
on spectroscopy, 16: 25091
on tellurium-132, 1939 to 1961, 16: 25301 (BLG/B-1)
on theory of surface electromagnetic waves, 16: 25959(T) (JPRS-13656(p.1-91))
on thermodynamic properties of actinide chalcogenides, 16: 25388
on thermodynamic properties of bismuth alloys, 16: 25391
on thermodynamic properties of plutonium, thorium, and uranium metals and oxides, 16: 25400
on unconventional power sources, 16: 25095 (SB-484)
BIOLOGICAL MATERIALS
cosmic radiation effects, during flight of Discoverer XVIII satellite, 16: 25173 (NP-11784)
BIOLOGICAL MODELS
of mitosis, 16: 25135(R) (HW-72500(p.104-8))
BIOLOGICAL SYSTEMS
radiation injury, review of protection against, 16: 25254
BIPHENYL–WATER SYSTEMS
drop coalescence at planar interfaces in, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
BIRDS
behavior of pigeons, effects of inhaled mercury vapor, 16: 25154 (UR-578)
waterfowl dispersion and migration patterns, tracer study, 16: 25142(R) (HW-72500(p.139-43))
BISMUTH

meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
neutron capture cross sections, 16: 26509
photofission cross sections up to 18.5 Mev, 16: 26261
properties, theory of infrared and optical, 16: 25758 (NP-11675)
proton fission at 660 Mev, charge spectra from, 16: 26329
proton reactions at 120 to 660 Mev, astatine isotope production in, 16: 26220 (JINR-P-950)
radioinduced heating, design of calorimeter for measuring gamma and neutron, 16: 26502
solvent properties for uranium, effects of alkali metals, 16: 25815 (BNL-5156)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
thermal desorption energy on glass and mica, 16: 26009

BISMUTH ALLOYS
thermodynamic properties, 16: 25391

BISMUTH ISOTOPES Bi-209
photofission cross sections, 16: 25949 (NP-11977(p.144-6))

BISMUTH ISOTOPES Bi-210
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356

BISMUTH ISOTOPES Bi-212
beta recoil from solid surfaces, 16: 26009

BISMUTH ISOTOPES Bi-214
beta recoil from solid surfaces, 16: 26009

BISMUTH SULFIDES
retention of intravenously injected colloidal, in rabbit organs, 16: 25104

BISMUTH–URANIUM ALLOYS
thermodynamic properties at 1020 to 1270°K, 16: 25387

BLADDER
iodine-131 deposition in urinary, gonad exposure from, 16: 25668

BLOOD
uranium content in rabbit, from inhalation and injection, 16: 25158
water absorbed by, from intestine, tracer study, 16: 25130(R) (HW-72500 (p.84-7))

BLOOD CELLS
phosphorus-32 injection effects on, in bone marrow and lymph in rabbits, 16: 25202
radiation effects *in vivo* and *in vitro*, 16: 25191
scanner, design of automatic, 16: 25568 (NYO-9644)

BLOOD PICTURE
radiation effects on, in prenatally exposed rats, 16: 25248

BLOOD PLASMA
radiotherapy effects on plasmin activity in, effects of ϵ-aminocaproic acid on, 16: 25161
transfer of heavy radionuclides from, to milk, 16: 25121(R) (HW-72500 (p.44-9))

BLOOD PRESSURE
radiation effects on, whole-body, 16: 25222

BLOOD SERUM
analysis for calcium-45, strontium-85, and phosphates in ultrafiltrates, 16: 25115(R) (HW-72500(p.19-22))

BOILERS
critical heat flux in pool boiling, effect of geometry and heater characteristics on, 16: 25525 (NAA-SR-Memo-6928)
design of high-pressure, high-temperature sodium, 16: 25502 (NAA-SR-Memo-6849)
fabrication, development of gas shielded-arc welding for, 16: 25740

BOILING
bibliography on metal, 16: 25522 (ASD-TR-61-594)
critical heat flux in pool, effect of geometry and heater characteristics on, 16: 25525 (NAA-SR-Memo-6928)
heat transfer in nucleate, on horizontal surfaces, 16: 25531

BOILING REACTOR EXPERIMENTS
development of BORAX-V, 16: 26455(R) (ANL-6573)

BOILING REACTORS
design of direct-cycle, 16: 26581(P)
development at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
fuel management, program evaluation for EURATOM, 16: 26464(R) (EURAEC-255)
stability studies of heavy water, 16: 26601(T) (AEC-tr-5078)

BONE MARROW
fractionation of cellular elements, 16: 25096(R) (TID-15980)
phosphorus-32 injection effects on blood cells in rabbit, 16: 25202
radiation effects on oxygen consumption in guinea pig, effects of dry injections on, 16: 25204
transplantation, immune reactions, 16: 25109

BONE TUMORS
detection of metastases after administration of fluorine-18, radiometric, 16: 25097(R) (TID-16081)

BONES
analysis for barium in ash, spectrographic, 16: 25286
analysis for strontium-90, samples collected in Great Britain, 1961, 16: 25168 (NP-11904)

BORATES
fluorescence of samarium-activated, 16: 25974

BORIDES
preparation, properties, and uses of refractory-metal, 16: 25768(T) (NASA-TT-F-102)
properties of high-melting, 16: 25835

BORON
analysis, 16: 25085 (JAERI-7022)
poisoning efficiency in radiochemical processes, 16: 25415 (ORNL-3309)

BORON ISOTOPES B-10
deuteron and proton inelastic scattering, excited states from, 16: 26265
deuteron reactions (d,pγ), gamma circular polarization from, 16: 26267
energy levels at 7.42 to 7.56 Mev, decay schemes, 16: 26281
energy levels, excitation by nuclear reactions, 16: 26265
energy levels, excitation by (p,γ) reactions on beryllium-9, 16: 26266
proton reactions at 2.4 to 7.2 Mev, excitation functions and gamma yields, 16: 26248

BORON ISOTOPES B-11
deuteron stripping reactions (d,p) at 13.8 Mev, proton polarization from, 16: 26347
energy level at 2.14 Mev, decay and spin-parity of, 16: 26302
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
neutron activation cross sections at 14.7 Mev, 16: 26268

BORON NITRIDES
reactions with sodium vapor at 940°C, 16: 25318 (RAD-TM-60-44)
thermodynamic properties at 300 to 1200°K, 16: 25401

BORON OXIDE–LITHIUM OXIDE SYSTEMS
entropy of vitrification, 16: 25325 (USNRDL-TR-566)

BORON OXIDE–RUBIDIUM OXIDE SYSTEMS
vapor pressures at 875 to 1554°C, 16: 25325 (USNRDL-TR-566)

BORON OXIDE–SODIUM OXIDE SYSTEMS
entropy of vitrifaction, 16: 25325 (USNRDL-TR-566)

BORON OXIDES
vapor pressure of liquid, 16: 25325 (USNRDL-TR-566)

BORON–URANIUM SYSTEMS
development for use as Phoenix fuels in compact reactors, 16: 26467(R) (HW-73100)

BOROSILICATE GLASS
reactions with sodium vapor at 940°C, 16: 25318 (RAD-TM-60-44)

BOSONS
decay, electromagnetic effects on, 16: 26148
interactions in one-dimensional system of, collective description of, 16: 26162
interactions, mass spectra from 4-body contact, 16: 26107
interactions of three-dimensional system of, collective description of, 16: 26163
interactions with mesons (π) and nucleons, meson multiple in, 16: 26170
photoproduction total cross sections for, in nuclear Coulomb fields, 16: 26362

BRAIN
radiation effects on cortex and subcortex of rabbits, prenatal exposure, 16: 25247
radioinduced chromosome aberrations in human fetal, 16: 25181(R) (TID-16317)

BRAIN TUMORS
localization by positron annihilation and unbalance scans after administration of arsenic-74, 16: 25102

BRAKES
lining material for aircraft, property data, 16: 25744(R) (AD-269196)

BRASS

beta recoil of bismuth-212 and -214 from, 16: 26009
BRAZING ALLOYS
development for bonding beryllium oxide to pyrolytic graphite, 16: 25739
BREASTS
radiotherapy of carcinomas of, lung tolerance dose in, 16: 25160
radiotherapy of cancer in, fibroatelectasis in postoperative, 16: 25165
radiotherapy of postoperative tumors, protective effects of adrenochrome against injuries during, 16: 25256
BREEDER REACTORS
behavior of fast, for long periods, 16: 26546
economics of fast, fission gas pressure effects on, 16: 26547
evaluation of uranium-233–thorium fast, 16: 26613 (NDA-2164-3)
fission product burnup in fast, 16: 26548
BREMSSTRAHLUNG
mechanisms in high-temperature plasmas, 16: 25879 (ARL-62-320)
polarization of external, relation to electric and magnetic fields, 16: 26106
production of quasi-monochromatic, by 1-Bev electron reactions on diamond, 16: 26136
scattering by nuclear excited states, resonant, 16: 26275
BRITISH REACTORS
cost factors, 16: 26606
development, review, 16: 25082 (DPR/INF/267)
BROMINE
neutron capture cross sections, 16: 26509
proton fission at 9 Bev, charge spectra from, 16: 26329
use of, in ethyl acetate solutions for selectively dissolving uranium mixed with uranium oxides, 16: 25483
BROMINE FLUORIDE–URANIUM(VI) FLUORIDE SYSTEMS
distillation in 0.5 inch-diameter packed column, 16: 25467 (ANL-6362)
BROMINE ISOTOPES Br-81
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
BROMOFORM
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
BUBBLE CHAMBERS
bubble density measurements in, 16: 25883 (CTSL-33)
bubble growth processes in, 16: 25945 (NP-11977(p.129-35))
data analysis, computer programming for, 16: 25904 (LNF-62/37 (p.157-8))
ionization measurements in hydrogen, parameters affecting, 16: 25921 (NP-11977(p.45-48))
uses, 16: 25925 (NP-11977(p.60-2))
BUBBLES
density measurements in bubble chambers, 16: 25883 (CTSL-33)
BUILDING MATERIALS
decontamination, evaluation of wetting agents for, 16: 25660(T) (JPRS-13691(p.8-12))
radioactivity from natural sources in Japan, 16: 25675
technical review, summary of committee reports on DOD research and development, 16: 25755 (MAB-180-M(Vol.II))
thermal radiation effects, 16: 25876(R) (AFSWP-844)
BUTADIENE POLYMERS
solution properties, effects on poly-dispersity and branching, 16: 25363
BUTANE
separation from deuterated isomers by partition chromatography, 16: 25427
BUTANE, 2,3-DIMETHYL-
separation from deuterated isomers by partition chromatography, 16: 25427
BUTANE, 2-METHYL-
separation from deuterated isomers by partition chromatography, 16: 25427
1-BUTANOL, 3-METHYL-
potentials of nickel electrode in, 16: 25322 (TID-16292)
2-BUTANONE
heat transfer in boiling, electroconvection effects on, 16: 25533
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354
BUTYL PHOSPHATE–KEROSENE–NITRIC ACID SYSTEMS
radiolysis, separation of dibutyl hydrogen and monobutyl dihydrogen phosphates from yields in, 16: 25420(R) (SRIA-62)
BUTYL PHOSPHATE–KEROSENE SYSTEMS
radiolysis, separation of dibutyl hydrogen and monobutyl dihydrogen phosphates from yields in, 16: 25420(R) (SRIA-62)
BUTYL PHOSPHATE–KEROSENE–WATER SYSTEMS
radiolysis, separation of dibutyl hydrogen and monobutyl dihydrogen phosphate from yields in, 16: 25420(R) (SRIA-62)
BUTYL PHOSPHATE–NITRIC ACID SYSTEMS
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
BUTYL PHOSPHATE–PHOSPHORIC ACID SYSTEMS
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
BUTYL PHOSPHATE–SULFURIC ACID SYSTEMS
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
BUTYL PHOSPHATE SYSTEMS
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
BUTYL PHOSPHATE–WATER SYSTEMS
drop coalescence at planar interfaces in, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
BUTYL PHOSPHATES
radiolysis, separation of dibutyl hydrogen and monobutyl dihydrogen phosphates from yields in, 16: 25420(R) (SRIA-62)
separation of mono- and di-, from tributyl phosphate radiolysis yields, 16: 25420(R) (SRIA-62)
solvent properties for europium and thorium nitrates, effects of diluents on, 16: 25489

C

CADMIUM
coprecipitation with zinc sulfide, 16: 25319 (TID-16128)
determination, micro-coulometric, 16: 25285
heat of adsorption on copper, glass, and silver, 16: 26009
neutron capture cross sections, 16: 26509
poisoning efficiency in radiochemical processes, 16: 25415 (ORNL-3389)
properties, theory of infrared and optical, 16: 25758 (NP-11675)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
CADMIUM–INDIUM–SILVER ALLOYS
neutron absorption properties of bare and nickel-plated, 16: 25796
CADMIUM ISOTOPES Cd-107
decay scheme, 16: 26280
CADMIUM ISOTOPES Cd-111
beta decay, mass discrepancies from, 16: 26287 (IS-408)
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
CADMIUM ISOTOPES Cd-112
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
CADMIUM ISOTOPES Cd-117
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
CADMIUM OXIDES
preparation and electrical and optical properties of crystals, 16: 25878 (ARL-62-319)
reactions with uranium oxide at high pressure and 900 to 1200°C, 16: 25302 (BMI-1585)
CADMIUM SELENIDE CRYSTALS
preparation and electrical and optical properties, 16: 25878 (ARL-62-319)
CADMIUM SULFIDE CRYSTALS
electric conductivity in, self-activated, 16: 25413(R) (NP-11882)
preparation and electrical and optical properties, 16: 25878 (ARL-62-319)
CADMIUM SULFIDES
interaction of electromagnetic and stress waves in, 16: 25547 (AROD-2302.8)
phase studies, 16: 25547 (AROD-2302.8)
CADMIUM TELLURIDES
preparation and electrical and optical properties of crystals, 16: 25878 (ARL-62-319)
CADMIUM TITANATES
crystal structure, 16: 25828
CADMIUM–URANIUM ALLOYS
thermodynamic properties at 450°C, 16: 25397

CALCINATION
of radioactive residues, equipment development, 16: 26639(R) (HW-73412)
pot temperature control, 16: 26640 (ORNL-TM-259)
CALCIUM
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
determination, micro-coulometric, 16: 25285
effects on wetting of cobalt, iron, and nickel by liquid sodium, 16: 25782
metabolism by plants, effects of chloramphenicol on uptake by roots, 16: 25139(R) (HW-72500(p.123-7))
metabolism in plants, effects of dinitrophenol, 16: 25140(R) (HW-72500 (p.128-33))
CALCIUM FLUORIDE CRYSTALS
radioactivity, relation of coloration and spectra to, 16: 25622
spectra, optical modes at 7750 to 14,360 kMc in, 16: 25978
CALCIUM ISOTOPES Ca-40
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
proton reactions (p,d), distributions from, 16: 26258
CALCIUM ISOTOPES Ca-45
absorption by intestine in rats, 16: 25114(R) (HW-72500(p.15-18))
determination in blood serum ultrafiltrates, 16: 25115(R) (HW-72500 (p.19-22))
metabolism, effects of age, in miniature swine, 16: 25113(R) (HW-72500(p.13-14))
uptake by heart ventricle, effects of ouabain, 16: 25107
CALCIUM OXIDES
reactions with uranium oxides at high pressure and 900 to 1200°C, 16: 25302 (BMI-1585)
CALCIUM TITANATES
emissivity and endurance, 16: 25761(R) (PWA-2088)
CALDER HALL REACTORS
cost factors, 16: 26606
CALIFORNIUM
separation from americium and curium by solvent extraction using 2-ethylhexylphenylphosphonic acid, 16: 25477 (ORNL-3273)
CALIFORNIUM ISOTOPES Cf-252
fission, neutron spectra from, 16: 26515
neutron fission to 15 Mev, prompt-neutron spectra from, 16: 26514
spontaneous fission, neutron angular distributions and velocities from, 16: 26320 (UCRL-9713(Rev.))
CALORIMETERS
design for nuclear heating measurements in reactors, 16: 26502
CALORIMETRY
for measurement of heats of formation, 16: 25404
use of oxygen- and fluorine-bomb, in measurement of heats of formation, 16: 25396
CAMERAS
radiation effects on image orthicon and vidicon, 16: 25836 (AD-270724)
CANADA
fall-out monitoring, Jan.–March 1962, 16: 25616(R) (NP-11914)
CAPRIC ACID
radioinduced polymerization of acrylonitrile to amide fiber, 16: 25431
CAPROIC ACIDS
6-amino-, effects on plasmin activity during radiotherapy of cancer patients, 16: 25161
CAPRYLIC ACIDS, THIO-
protective effects against radiation injuries in mice, 16: 25253
CARBIDES
heats of formation, 16: 25404
preparation, properties, and uses of refractory-metal, 16: 25768(T) (NASA-TT-F-102)
properties of high-melting, 16: 25835
CARBON
corrosive effects on niobium and vanadium at operating conditions of Dounreay Fast Reactor, 16: 26475 (TID-7622(p.35-56))
determination in niobium and its alloys, 16: 25294
determination in uranium(IV) fluorides, infrared spectrophotometric, 16: 25283 (TID-12773)
effects on corrosive effects of iron-plutonium alloys on tantalum, 16: 26577(P)
meson (π^-) elastic scattering at 5 to 15 Mev, angular distribution from, 16: 26365
meson (π^-) reactions at 2.8 Bev, K^o and Λ^o production in, 16: 26189
mesons (μ) pair photoproduction in, 16: 25899 (LNF-62/37(p.105-9))
mesons (μ) transfer in mesic, 16: 26219 (JINR-P-942)
neutron capture cross sections, 16: 26509
production of dense impermeable, 16: 25743(P)
production of impermeable, by impregnation, 16: 25742(P)
properties, 16: 25774
proton scattering, calculation of reduced widths from, 16: 25877(R) (ANL-6534)
sorption effects on ductile-to-brittle transition in alloyed and unalloyed refractory metals, 16: 25751 (DMIC-Memo-155)
CARBON COATINGS
deposition on thorium–uranium carbides, apparatus for, 16: 25731 (GA-2241)
preparation and properties, 16: 26476 (TID-7622(p.57-73))
CARBON DIOXIDES
corrosive effects on beryllium, effects of anodic films, 16: 25724
determination in lunar atmosphere, 16: 26049
determination in solid carbonates, microdiffusion, 16: 25291
oxidation of beryllium above 500°C, 16: 25725
purification, properties of desiccants for, 16: 25299 (AAEC/E-86)
reactions with copper oxides, isotopic effects of carbon-12 and -14 on, 16: 25410 (CEA-2120)
CARBON ISOTOPES C-10
half life, 16: 26244
CARBON ISOTOPES C-11
energy levels at 11.45 to 13.91 Mev, 16: 26248
CARBON ISOTOPES C-12
deuteron elastic scattering followed by reactions (d,p), yield asymmetries from, 16: 26338
deuteron reactions (d,α), excited states of boron-10 from, 16: 26265
deuteron reactions (d,p) at 6 Mev, effects of spin-orbit distortion, 16: 26284
electron scattering, effects of charge on bremsstrahlung emission in, 16: 26348
energy level at 4.43 Mev, nuclear model analysis of, 16: 26278
lithium nucleus reactions (lithium-6,α) and (lithium-7,α), differential cross sections for, 16: 26321
lithium-6 reactions (Li^6,α), angular distributions from, 16: 26249
neutron reactions (n,α) at 15 Mev, spectra from, 16: 26288
neutron scattering at 15 Mev, spectra from, 16: 26288
proton elastic scattering at 5.4 to 19.7 Mev, polarization effects, 16: 26263
proton inelastic scattering cross sections at 180 Mev, 16: 26279
proton quasi-elastic scattering cross sections, 16: 26273
CARBON ISOTOPES C-13
energy levels, 16: 26288
CARBON ISOTOPES C-14
determination in gas chromatography effluents using ionization chambers, 16: 25428
properties as beta source, 16: 26108
recoil effects in ethylbenzene and toluene, 16: 25438
CARBON MONOXIDES
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
reactions with helium, ionization cross sections, 16: 26238
CARBON STEEL
tensile properties, effects of niobium, 16: 25792
tensile properties, effects of niobium, 16: 25811
CARBON TETRACHLORIDE
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
photolyses in presence of ethylene, 16: 25419(R) (RRL-84)
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
CARBON–THORIUM–URANIUM SYSTEMS
krypton and xenon release at 900 to 2000°C from irradiated, 16: 25752 (GA-3211)
CARBONATES

analysis for carbon dioxides, microdiffusion, 16: 25291
coprecipitation from homogeneous aqueous solutions, 16: 25319 (TID-16128)
CARCINOGENESIS
etiology, inherited and somatic mutations in, 16: 25106
CARCINOMAS
radiation effects combined with hematoporphyrin on glycolysis in human, 16: 25234
radioinduced by therapy of non-malignant diseases in neck and pharynx, 16: 25201
radiotherapy of breast, lung tolerance dose in, 16: 25160
radiotherapy of postoperative breast, fibroatelectasis in, 16: 25165
CAROLINAS-VIRGINIA TUBE REACTOR
control rods and drive mechanisms for, development of, 16: 26589 (CVNA-121)
coolant loss, computer analysis of behavior in, 16: 26587 (CVNA-117 (Vol.I))
development, 16: 26600(R) (WCAP-4126)
moderator tank design, 16: 26586 (CVNA-108)
pressure tube design, 16: 26585 (CVNA-95)
CASCADE SHOWERS
distributions from cosmic particles on emulsion nuclei, 16: 26296
CASEIN
protective effects against radiation damage in gonads, 16: 25233
CATALYSIS
conference on isotopes in, summary, 16: 25261(T) (JPRS-13785)
CATION EXCHANGE MATERIALS
performance for separation of cesium and strontium from condensate waste solutions, 16: 26638 (HW-71627)
CATIONS
electron recombination with, 16: 26031
separation of vanadium(IV and V) from 25, by ion exchange, 16: 25484 (IS-415)
CAVES
design and construction, bibliography, 16: 25500 (KFK-69)
design and testing, for radiochemical procedures, 16: 25260 (JAERI-1029)
CAVITY RESONATORS
radiation effects on properties of piezoelectric, 16: 25857
CELLULOSE
sorption properties for uranyl ions, 16: 25336
CEMENTS
development and testing of, for strain gage use at 1600°F, 16: 25560 (NAMC-ASL-1050(Pt.III))
CERAMIC COATINGS
deposition on uranium and uranium dioxide particles, 16: 26479 (TID-7622(p.98-107))
development for reactor fuel particles, 16: 26476 (TID-7622(p.57-73))
CERAMIC MATERIALS
decontamination by removal of iron-59 activity, evaluation of wetting agents for, 16: 25660(T) (JPRS-13691(p.8-12))
development for propulsion systems, 16: 26633
thermal radiation effects, 16: 25876(R) (AFSWP-844)
CERIUM
determination in silicate rocks, combined cation exchange-spectrochemical, 16: 25287
determination, micro-coulometric, 16: 25285
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
neutron capture cross sections, 16: 26509
phase transformations at 20 to 475°K and 0 to 10,000 atm, 16: 25797
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
solvent properties for plutonium, 16: 25474 (IS-470)
CERIUM CHLORIDES
free energy of formation at 400 to 600°C, 16: 25392
CERIUM ETHYL SULFATES
gamma distribution from cerium-141 in, 16: 26242
CERIUM ISOTOPES Ce-141
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
gamma distribution from, oriented in cerium and neodymium ethyl sulfates, 16: 26242
nuclear alignment in cerium magnesium nitrate, 16: 26224 (NP-11865)
CERIUM ISOTOPES Ce-144
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
clearance of inhaled particles from lungs, effects of various treatments, 16: 25127(R) (HW-72500(p.74-6))
neutron capture by, resonance integral and thermal cross section for, 16: 26294
transfer from plasma to milk, 16: 25121(R) (HW-72500(p.44-9))
CERIUM OXIDES
thermodynamic properties, 16: 25386
CESIUM
corrosive effects on containment alloys and metals at high temperatures, review, 16: 25714 (DMIC-169)
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
effects on solubility of uranium in bismuth, 16: 25815 (BNL-5156)
heat of adsorption on tungsten, 16: 26009
separation by ion exchange on thallous phosphotungstate, 16: 25485
separation from condensate wastes containing ammonia by cation exchange, 16: 26638 (HW-71627)
separation from solutions by ion exchange, 16: 26467(R) (HW-73100)
solvent extraction from molybdate-phosphate solutions, 16: 25472 (AERE-R-4039)
CESIUM IONS
oscillation excitation in plasma by, low-frequency, 16: 26427
separation by ion exchange on thallous phosphotungstate, 16: 25485
CESIUM ISOTOPES Cs-133
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
CESIUM ISOTOPES Cs-137
absorption by cultivated plants, 16: 25642 (CEA-2159)
determination in fission gases, spectrometric, 16: 25295
determination in residents of northern Europe, whole-body counting, 16: 25167(R) (NP-11884)
gamma spectra at 0.662 Mev, 16: 26239
metabolism by animals and humans, 16: 25157
uptake by plants, effects of nutrient potassium and cesium, 16: 25141(R) (HW-72500(p.134-8))
CESIUM ISOTOPES Cs-138
determination in fission gases, spectrometric, 16: 25295
CESIUM NITRATES
radiolysis, lattice compressibility relation to, 16: 25453
CHARGED PARTICLE BEAMS
analysis, theory of H.F. separators for use in, 16: 26369-(CEA-2109)
reactions with plasma in magnetic fields, nonlinear theory of, 16: 2642
stability penetrating plasma, 16: 26397 (AD-269051)
CHARGED PARTICLES
angular distribution data for, computer program for analysis of, 16: 26227 (ORNL-3251)
Cherenkov emission by, radiation corrections for intensity, 16: 26098
diffusion in parabolic electric potential well, 16: 25885 (GEST-2002)
friction of, in plasma, 16: 26426
interactions, expectation value in quasi-chemical equilibrium theory of, 16: 26012
mobilities, 16: 26040
motion in betatrons, accuracy of expressions for, 16: 26386(T) (FTD-TT-61-242(p.129-33))
motion in electromagnetic fields, computer analysis, 16: 26377(T) (FTD-TT-61-242(p.1-2))
motion in static potentials, Schrödinger equation solution for one-dimensional, 16: 26172
reactions with aluminum and silver foils, gamma spectra from, 16: 2634
reactions with atoms and molecules, energy transfers in, 16: 26039
CHEMICAL PROPHYLAXIS
characteristics and mechanisms in, 16: 25254
compounds for, preparation of, 16: 25249(R) (NP-11740)
of radiation injuries, role of copper component of cytochrome c oxidase, 16: 25174 (TID-11988)
of radiation sickness with Marzine, 16: 25259
CHEMICAL RADIATION DETECTORS
design and performance as dosimeter for gamma radiation, 16: 25561 (NDL-TR-7)
CHEMICALS AND REAGENTS

synergistic effects of mutagenic, with x radiation in tobacco seeds, 16: 25193 (CNEN-118)
synergistic effects of mutagenic, with radiation on growth of wheat seedlings, 16: 25194 (CNEN-124)
CHERENKOV DETECTORS
design for monitoring reactor coolant, 16: 25596(P)
design for monitoring power of water-cooled reactors, 16: 25597(P)
design for monitoring reactor coolants for fission products, 16: 25598(P)
CHERENKOV RADIATION
emission by charged particles, radiation corrections for, 16: 26098
intensity lateral distributions of, in cosmic showers, 16: 26062
meson spectra analogy to, 16: 26096
CHICKENS
radiation effects on DNA and RNA content in embryos, gamma and x, 16: 25207
CHILE
heavy water content in natural waters of Concepción Region, 16: 25621
CHITIN
solvent properties for uranium in dilute carbonate media, 16: 25487
CHLORAMPHENICOL
effects on cation absorption by plants, 16: 25139(R) (HW-72500 (p.123-7))
CHLORIDES
determination in nitric acid by deposition on mercury electrode, 16: 25272(R) (TID-16332)
meson (π^-) reactions at 2.8 Bev, K^0 and Λ^0 production in, 16: 26189
CHLORINE
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
isotope effects in reactions of benzyl chlorides with cyanides, thiosulfates, and water, 16: 25344
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
CHLORINE ISOTOPES Cl-34
oxidation states in irradiated compounds, 16: 25443
CHLORINE ISOTOPES Cl-35
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
CHLORINE ISOTOPES Cl-36
oxidation states in neutron-irradiated compounds and minerals, 16: 25443
CHLORINE ISOTOPES Cl-37
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
CHLORINE ISOTOPES Cl-38
oxidation states in irradiated compounds, 16: 25443
CHLOROFORM
diluent effects on extraction of europium and thorium nitrates by tributylphosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
CHLOROPHYLLS
exchange of magnesium-28 with chlorophyll a, 16: 25155
CHROMATES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
CHROMATOGRAPHY
effluent radioactivity measurement with ionization chamber, 16: 25428
CHROMIUM
determination in niobium and its alloys, 16: 25294
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
effects on corrosion resistance of iron and steels, 16: 25721(T) (FTD-TT-61-31(p.60-9))
fluorescence, K-shell yields, 16: 26000
neutron capture cross sections, 16: 26509
phase transition in alloyed and unalloyed, effects of interstitials on ductile-to-brittle, 16: 25751 (DMIC-Memo-155)
CHROMIUM BORIDES
thermodynamic properties at 300 to 1200°K, 16: 25401
CHROMIUM FLUORIDES
phase equilibria in mixed, 16: 25340
CHROMIUM–IRON ALLOYS
fission-product diffusion in, 16: 25750(R) (BMI-X-196)
stress-corrosion cracking of high-strength, in synthetic environment, 16: 25717(R) (NP-11948)
CHROMIUM–IRON–OXYGEN SYSTEMS
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
CHROMIUM ISOTOPES Cr-50
proton reactions (p,γ) at 0.7 to 1.4 Mev, energy levels from, 16: 26235
CHROMIUM ISOTOPES Cr-51
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
CHROMIUM ISOTOPES Cr-52
deuteron elastic scattering, absorptive effects in, 16: 26342
proton reactions (p,γ) at 0.7 to 1.4 Mev, energy levels from, 16: 26235
CHROMIUM ISOTOPES Cr-53
proton reactions (p,γ) at 0.7 to 1.4 Mev, energy levels from, 16: 26235
CHROMIUM ISOTOPES Cr-54
proton reactions (p,γ) at 0.7 to 1.4 Mev, energy levels from, 16: 26235
CHROMIUM OXIDES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
CHROMIUM–TITANIUM ALLOYS
phase transformations, 16: 25830
CHROMIUM–URANIUM OXIDE SYSTEMS (CLAD)
fabrication and oxidation resistance of aluminum oxide clad, 16: 25749 (BMI-1586)
CHROMOSOMES
radioinduced aberrations in human fetal brain and lung tissue, 16: 25181(R) (TID-16317)
radioinduced aberrations in developing sperm, 16: 25192
radioinduced aberrations in root meristems, 16: 25217
CIRCUITS
transfer function analysis by external network for automatic, 16: 25543 (AEEW-R-154)
CIRCULATORY DISEASES
diagnosis, tracer method using barium-137, 16: 25097(R) (TID-16081)
CLEANING
ultrasonic, of organic moderated fuel elements, 16: 25700(R) (NYO-10282)
CLEANING SOLUTIONS
selection for ultrasonic cleaning of organic moderated fuel elements, 16: 25700(R) (NYO-10282)
CLOTHING
contamination of Quartermaster Corps, by dry fall-out, 16: 25656 (USNRDL-TR-557)
thermal radiation effects, 16: 25876(R) (AFSWP-844)
CLOUD-ION CHAMBERS
frequency response of current, 16: 25587
CLOUDS
electric activity and structure, effects of nitric oxide ions, 16: 25625
COAL
analysis for moisture by neutron moderation, 16: 25682(R) (TID-16013)
analysis for moisture content in large storage piles, neutron moderation method, 16: 25271(R) (TID-16156)
analysis for moisture content by elastic back-scattering of fast neutrons, 16: 25296
hydrogenation of gamma and x irradiated, 16: 25408 (BM-RI-6022)
processing, evaluation of beta radiation as hydrogenation catalysis in, 16: 25414(R) (NYO-10184)
COAL DEPOSITS
exploration of boreholes by gamma/gamma logging, 16: 25637
COATINGS
deposition, chemical vapor, 16: 25308 (DMIC-170)
COAXIAL CABLES
bibliography on radiation effects on, 16: 25846 (NP-11929)
COBALT
determination in aluminum, activation, 16: 25288
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
neutron capture cross sections, 16: 26509
properties, theory of infrared and optical, 16: 25758 (NP-11675)
wetting by liquid sodium, effects of additions of barium and calcium to sodium and of oxide films, 16: 25782
COBALT ALLOYS
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)
COBALT–COPPER ALLOYS
deformation and second-phase particles in, 16: 25693 (ARL-62-357)
magnetocrystalline anisotropy of fcc cobalt in, 16: 25882 (ASD-TR-61-

630)
COBALT CRYSTALS
magnetocrystalline anisotropy of face-centered, 16: 25882 (ASD-TR-61-630)
COBALT IONS
exchange between divalent and trivalent, in perchloric acid, 16: 25353
COBALT ISOTOPES
exchange in perchloric acid media, 16: 25353
COBALT ISOTOPES Co-57
electron capture decay, K-shell fractions, 16: 26336
Mössbauer effect in, line broadening and transmission in, 16: 26225 (NP-11913)
COBALT ISOTOPES Co-58
decay, K-capture-positron emission ratio, 16: 26337
COBALT ISOTOPES Co-59
nuclear magnetic resonance in cobalt powders, 16: 25882 (ASD-TR-61-630)
proton reactions (p,n) at 17 Mev, effects of excited isobaric states, 16: 26333 (UCRL-6830)
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
COBALT ISOTOPES Co-60
determination as contaminant in phosphorus-32 humic preparations, spectrometric, 16: 25448
COBALT MANGANESE OXIDES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
COLUMBIA RIVER
incidence and virulence of *Chondrococcus columnaris*, 1960 and 1961, 16: 25145(R) (HW-72500(p.151-5))
salmon spawning in, 1961, 16: 25144(R) (HW-72500(p.148-50))
COMPUTER PROGRAMS
ALP, analysis of coolant loss in heavy water reactors, for IBM 7090, 16: 26587 (CVNA-117(Vol.I))
ALPS for analysis of loss-of-coolant accident for multi-circuit core nuclear power plant, 16: 26588 (CVNA-117(Vol.II))
FICS, for few-group constants in KARE diffusion theory system using Philco 2000, 16: 26196 (KAPL-M-RPC-3)
for synthesizing linear automatic control systems, 16: 26454 (AEEW-R-156)
KINEMATICS II, for analysis of nuclear reaction angular distribution data, Fortran for IBM-7090, 16: 26227 (ORNL-3251)
MURGATROYD, analysis of reactor power vs time, for IBM 7090, (ORNL-TM-203(Add.))
PERT, for project scheduling, LGP-30, 16: 25081 (CRIO-1091)
punched card library of neutron cross sections, 16: 26520
SOR-II for stress analysis of shells of revolution on Philco-2000, 16: 26470 (KAPL-2000-18)
STABLE-3 for hydraulic flow stability analysis on Philco-2000, 16: 26470 (KAPL-2000-18)
THERMØS for reactor lattice calculations on IBM 704, 709, and 7090, 16: 26459 (BNL-5826)
TNT, for analysis of transient performance of HTGR fission product trapping system, Fortran for IBM-7090, 16: 26593 (GAMD-3168)
TTD for calculation of two-dimensional steady-state temperature distributions on Philco-2000, 16: 26470 (KAPL-2000-18)
TYCHE, for analysis of second, fourth, and sixth moments of neutron slowing down distribution, Fortran for IBM-7090, 16: 26197 (NAA-SR-7357)
VEP for determination of behavior of vibrating structural system on Philco-2000, 16: 26470 (KAPL-2000-18)
WHY, one-dimensional few-group diffusion code for IBM-1620, 16: 26195 (KAPL-M-CT-1)
20-8, for interpreting program 18-0 source and escape particle tapes, IBM 7090, 16: 26466 (GEMP-123)
COMPUTERS
calibration for Shippingport Pressurized Water Reactor, 16: 26591 (DLCS-4000301(Rev.))
programming for analysis of bubble chamber photographs, 16: 25904 (LNF-62/37(p.157-8))
use in solution of equations for particle motion in electromagnetic fields, 16: 26377(T) (FTD-TT-61-242(p.1-2))
uses in digitization of seismic data for detection of underground nuclear explosions, 16: 25610 (AFCRL-863)
CONCRETES
gamma and prompt neutron attenuation, 16: 25415 (ORNL-3309)
properties as reactor material, 16: 25781
CONDENSERS
performance, nomograms for calculation, 16: 25540 (AD-269401)
CONFERENCES
AWS 43rd Annual Meeting and ASME Metals Engineering Conference, Cleveland, Ohio, April 9 to 13, 1962, 16: 25741
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CONNECTIVE TISSUE
phosphorus-32 uptake by subcutaneous, 16: 25164
CONNECTORS (ELECTRIC)
design of remotely actuated quick-disconnect, 16: 25602(P)
CONSTITUTION DIAGRAMS
correlation with free energies, 16: 25374
CONVECTION (FORCED)
heat transfer and pressure drop in steam-water flow in vertical annuli, 16: 25519 (AERE-R-3808)
CONVERSION ELECTRONS
polarization, transverse, 16: 26086 (NP-11737)
COPPER
adsorptive properties for cadmium, 16: 26009
alpha reactions (α,n), range of gallium-66 ions from, 16: 26243
determination in aluminum, activation, 16: 25288
determination in gallium arsenides by neutron activation, 16: 25293
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
determination, micro-coulometric, 16: 25285
fluorescence, K-shell yields, 16: 26000
fracture under impulsive loading, 16: 25759 (NP-11890)
meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
metabolism, effects of molybdate, 16: 25151(R) (TID-16073)
neutron capture cross sections, 16: 26509
nitrogen-14 and -15 reactions, neutron transfer in, 16: 26221 (JINR-P-973)
paramagnetism of iron impurities in, 16: 25999
properties, theory of infrared and optical, 16: 25758 (NP-11675)
role in radiation injuries and chemical radiation protection, 16: 25174 (TID-11988)
separation of impurities from, by ion bombardment and heating, 16: 25
solvent properties for zirconium, 16: 25794
surface tension of liquid, relation to critical temperature and surface

energy, 16: 25351
COPPER CRYSTALS
hardening of single, effects of purity and temperature on, 16: 25769(T) (SCL-T-434)
COPPER ISOTOPES Cu-63
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
neutron activation cross sections at 14.7 Mev, 16: 26268
proton inelastic scattering at 6.6 Mev, 16: 26349
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
COPPER ISOTOPES Cu-64
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
COPPER ISOTOPES Cu-65
neutron activation cross sections at 14.7 Mev, 16: 26268
proton inelastic scattering at 6.6 Mev, 16: 26349
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
COPPER ISOTOPES Cu-66
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
COPPER OXIDES
reduction by carbon-12 and -14 labeled carbon dioxide, isotopic effects in, 16: 25410 (CEA-2120)
CORROSION LOOPS
design, 16: 26603(T,R) (EURAEC-36)
design of IFA high-temperature water, 16: 25715 (KR-14)
development, 16: 26604(T,R) (EURAEC-38)
COSMIC MESONS (μ)
spectra, sources of error in measurements of momentum, 16: 26055
COSMIC MESONS (π)
cosmic photon production by, 16: 26058
COSMIC PARTICLES
production by supernovae, configurations of, 16: 26048
reactions on emulsion nuclei at 3×10^{14} ev, 16: 26296
COSMIC PHOTONS
interactions with cosmic radiation at high energies, 16: 26058
production by mesons (π^0) at high energies, 16: 26058
COSMIC PROTONS
detection and measurement in rocket flights November 1960, 16: 26052 (NASA-TN-D-1139)
COSMIC RADIATION
auroral emission spectra, intensity of helium line at 10830 Å, 16: 26002
biological effects, 16: 25173 (NP-11784)
detection of auroral rays with east-west speeds of 13 to 30 km/sec, 16: 26060
diurnal variations, theory for sidereal and anti-sidereal, 16: 26054
effects on isotopic composition of iron meteorites, 16: 25614 (JPL-TR-32-147)
intensity variations in geomagnetic fields and space, 16: 26053
interactions with photons at high energies, meson (π^0) production in intergalactic, 16: 26058
origin and properties review, 16: 26061
variations caused by solar winds, diurnal, 16: 26059
COSMIC SHOWERS
Cherenkov radiation intensity lateral distributions in, 16: 26062
model for primary jets, phenomenological, 16: 26056
production of extensive, by photons at high energies, 16: 26058
COSMOLOGY
meteor train characteristics, 16: 26047(T) (FTD-TT-62-165)
COULOMETRY
methods of micro-, in radiochemical analysis, 16: 25285
COUNTING DEVICES
design of direct coupled progressive stage pulse type, 16: 25601(P)
CRATERS
characteristics, formation, and scaling, 16: 25503 (NP-11816)
formation by explosion of 100 tons of TNT, 16: 25087 (NP-11817)
CRITICAL ASSEMBLIES
buckling of seven-element uranium dioxide clusters in ZED-2, 16: 26461 (CRRP-1072)
characteristics, comparison of theoretical and measurements by ZPR-III, 16: 26534
computational and experimental correlations of Godiva and Topsy, 16: 26533 (TID-13176)
criticality studies, carbide and oxide fuel performance in large dilute systems, 16: 26524
design and construction of ZPR-IV, 16: 26526
design of RACHEL, 16: 26527
integral experiments on plutonium, thorium, and uranium fast systems, 16: 26522
neutron properties of RACHEL, 16: 26528
safety analyses of experimental zero-power, 16: 26565
supports for, design of aluminum, 16: 25705 (BNL-4932)
CRITICALITY STUDIES
constants for slab and spherical reactors, calculations, 16: 26064 (RM-2917-PR)
critical mass calculations, sensitivity to changes in neutron scattering data, 16: 26541
CRUCIBLES
susceptor design and fabrication from refractory materials, 16: 25704
CRYOGENICS
use in nuclear rocketry, 16: 25516
CRYSTAL STRUCTURE
dynamics of harmonically coupled, one-dimensional lattices containing impurities, statistical, 16: 26014
electron-phonon interactions in, expectation value for, 16: 26012
electron reactions with, relation to superconductivity, 16: 25987
CRYSTALS
diffusion of impurity-vacancy pairs in, correlation factors, 16: 25992
gamma resonance absorption by impurity atoms in, 16: 26316
growth by chemical vapor deposition, 16: 25308 (DMIC-170)
neutron elastic resonance scattering in, 16: 26203(T) (AEC-tr-5145)
spectra, forbidden transitions in, 16: 26025
CURIUM
separation from transcurium elements by solvent extraction using 2-ethylhexylphenylphosphonic acid, 16: 25477 (ORNL-3273)
CURRENT REGULATORS
design of transistorized, for cyclotron magnet, 16: 25566 (NP-11883)
CYANIDE IONS
reactions with benzyl chlorides, chlorine isotope effects in, 16: 25344
CYCLOHEXANE
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
CYCLOPENTADIENYL COMPOUNDS
synthesis of rare earth, 16: 25321(R) (TID-16224)
CYCLOTRON RADIATION
electron beam oscillation effects, 16: 26393
mechanisms in high-temperature plasmas, 16: 25879 (ARL-62-320)
CYCLOTRONS
beam resonances in relativistic, 16: 26372 (JINR-P-931)
design and construction of University of Michigan 83-inch spiral-ridge, 16: 26375(R) (TID-16329)
electron oscillations in, 16: 26393
magnet current regulator, design of transistorized generator voltage control, 16: 25566 (NP-11883)
motion of electrons in, effects of scattering fields, 16: 26391(T) (FTD-TT-61-242(p.167-82))
storage ring design for electrons and positrons, 16: 25930 (NP-11977 (p.80-8))
CYLINDERS
flow between rotating, stability of viscous, 16: 25537
magnetohydrodynamic flow about, 16: 25874 (AFOSR-2714)
CYSTEINE
protective effects against ultrasoft x-radiation damage to mast cells in rats skin, 16: 25206
protective effects against glucose and pyruvic acid oxidation decrease in bacteria, 16: 25223
protective effects against radiation injuries in mice, 16: 25253
protective effects against radioinduced anti-infection resistance in mice, 16: 25258
protective effects against repeated partial-body radiation, 16: 25129(R) (HW-72500(p.81-3))
CYSTINE

protective effects against radiation injuries in mice, 16: 25253
CYTOCHROME OXIDASE
copper component, role in radiation injuries and radiation protection by chemical, 16: 25174 (TID-11988)
CYTOLOGY
cosmic radiation effects on cells, 16: 25173 (NP-11784)

D

DANGER COEFFICIENTS
tables, 16: 26194 (JAERI-6010)
DATA RECORDING SYSTEMS
calibration for Shippingport Pressurized Water Reactor, 16: 26591 (DLCS-4000301(Rev.))
DECANE
radioinduced crosslinking by ultraviolet light in presence of sensitizers, 16: 25455
DECONTAMINATION
of buildings, equipment and procedures, 16: 25498 (AECL-1531)
DECONTAMINATION OF EQUIPMENT
procedures, 16: 25498 (AECL-1531)
DECONTAMINATION OF PERSONNEL
procedures, 16: 25498 (AECL-1531)
DENMARK
fall-out monitoring, 1961, 16: 25169 (RISÖ-41)
DEUTERIUM
deuteron reactions (d,n) at 4 Mev, neutron emission in, 16: 26306
exchange with hydrogen, catalytic effects of doped germanium, 16: 25355
isotope effects in ethane, determination of secondary, 16: 25348 (IS-454)
meson (π^-) capture, branching ratio for, 16: 26232 (UCRL-9884)
mesons (π^-) photoproduction in, 16: 25943 (NP-11977(p.124-6))
separation from hydrogen, process based on spectrometric resonance for, 16: 25688(T) (AEC-tr-5199)
stopping power for recoil ions from alpha reactions (α,n), 16: 26243
DEUTERONS
interactions with neutrons at 0.5 to 1.0 Mev, polarization effects, 16: 26101
interactions with neutrons below 2 Mev, polarization effects, 16: 26102
interactions with mesons (π^+), meson (η) and (ω) production and properties from, 16: 26165
reactions (d,α) with silicon-28 at 5.5 to 7.5 Mev, angular distributions and cross sections for, 16: 26309
reactions (d, helium-3) with aluminum-27 at 12.8 Mev, angular distributions and magnesium-26 energy levels from, 16: 26313
reactions (d,n) with deuterium and titanium-48 at 4 Mev, neutron emission in, 16: 26306
reactions (d,p) on carbon-12 following elastic scattering by carbon-12, yield asymmetries from, 16: 26338
reactions (d,p) with fluorine-19, resonances and stripping reduced widths in, 16: 26339
reactions (d,p) with nuclei at 13.6 Mev, proton spectra from, 16: 26356
reactions (d,t) with five titanium isotopes at 21.4 Mev, 16: 25877(R) (ANL-6534)
reactions (d,2n) with antimony-121 at 9 to 28 Mev, tellurium yield ratios from, 16: 26240
reactions with lead at 400 Mev, production of astatine isotopes in, 16: 26220 (JINR-P-950)
scattering by nuclei with deformation of arbitrary multipolarity, diffraction, 16: 26228 (PAN-300/VII)
scattering by nuclei, absorptive effects in elastic, 16: 26342
stripping on non-axial nuclei, 16: 26350
stripping reactions (d,p) on selenium-76 at 7.8 Mev, cross sections for, 16: 26300
stripping reactions (d,p) on nuclei, effects of spin-orbit distortion, 16: 26284
DIAMONDS
electron scattering at 1 Bev, quasi-monochromatic bremsstrahlung from, 16: 26136
DIELECTRIC CONSTANTS
calculation for dense gas of plasma, 16: 25875 (AFSWC-TDR-62-21)
DIELECTRICS
radiation effects on physical properties of polymeric, 16: 25426
DIFFRACTION
analysis at high energies, using Regge poles, 16: 26154
behavior of cross sections at high energies, 16: 26447
DIFFUSION
coefficients and cross sections for, 16: 26040
correlation factors for impurity-vacancy pair-type, in crystals, 16: 25992
DOGS
effects of continual ingestion of strontium-90 during growth period in beagles, 16: 25153(R) (UCD-106)
radiation effects on work capacity and life span of beagles, 16: 25183(R) (UCD-105)
radiation effects on hematopoietic system in, 16: 25205
DOUNREAY FAST REACTOR
design and characteristics of, 16: 26566
fuel element causing corrosion, effects of impurities in coolant, 16: 26475 (TID-7622(p.35-56))
DROPS
coalescence at planar interfaces, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
DROSOPHILA
radioinduced mutations in, doubling dose for, 16: 25210
DRUGS
effects of ouabain on calcium uptake and contraction of heart ventricle, 16: 25107
DRY BOXES
inert atmosphere production and uses in, 16: 25517
DYSPROSIUM
crystal structure, magnetic energy effects on, 16: 25801
determination in uranium, spectrographic and spectrophotometric, 16: 25266 (CNEN-135)
neutron capture cross sections, 16: 26509
properties, theory of infrared and optical, 16: 25758 (NP-11675)
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
DYSPROSIUM COMPLEXES
with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, synthesis, 16: 25321(R) (TID-16224)
DYSPROSIUM–HOLMIUM–MANGANESE ALLOYS
phase studies, Laves, 16: 25798
DYSPROSIUM–IRON–MANGANESE ALLOYS
phase studies, Laves, 16: 25798
DYSPROSIUM ISOTOPES Dy-160
gamma spectra from, 16: 26346
DYSPROSIUM ISOTOPES Dy-161
neutron capture cross sections at 10^3 to 10^4 ev, 16: 26518
DYSPROSIUM ISOTOPES Dy-162
neutron capture cross sections at 10^3 to 10^4 ev, 16: 26518
DYSPROSIUM ISOTOPES Dy-163
neutron capture cross sections at 10^3 to 10^4 ev, 16: 26518
DYSPROSIUM–MANGANESE–THULIUM ALLOYS
phase studies, Laves, 16: 25798

E

EARTH
deformations near surface caused by explosion of 100-ton TNT charge, 16: 25087 (NP-11817)
ECOLOGY
in area of Ispra I, 16: 25166 (CNI-54)
in desert soil, 16: 25148(R) (HW-72500(p.161-4))
of mesophytic forest, terrestrial mineral cycling, tracer study, 16: 25150(R) (TID-15963)
EINSTEINIUM
separation from americium and curium by solvent extraction using 2-ethylhexylphenylphosphonic acid, 16: 25477 (ORNL-3273)
EINSTEINIUM ISOTOPES E_s-253
alpha emission, berkelium-249 energy levels from, 16: 26289
EINSTEINIUM ISOTOPES E_s-254
decay scheme, 16: 26289
ELASTOMERS
radiation effects on engineering properties, 16: 25843 (NARF-62-ST)
radioinduced graft polymerization of monomers on synthetic,

16: 25871(P)
ELECTRIC ARCS
motion of ball-of-fire and cathode spot during, in magnetic fields, 16: 26018
ELECTRIC CONDENSERS
impedance of parallel-plate plasma, 16: 25552 (D1-82-0173)
ELECTRIC CONDUCTIVITY
measurement during reactor irradiations, device for, 16: 25582
ELECTRIC CONTROL SYSTEMS
analysis, effects of linear elements with variable parameters, 16: 25510(T) (DEG-Inf-Ser-262)
development in USSR, 16: 25567 (NP-11947)
transfer function analysis by external network for automatic, 16: 25543 (AEEW-R-154)
ELECTRIC DISCHARGE
ionization processes in noble gases between parallel-plate electrodes, 16: 26008
ELECTRIC FIELDS
distribution function of micro-, in high-temperature plasma, 16: 26429
electron elastic scattering, 16: 26033
heat transfer effects in boiling liquids, 16: 25533
Schottky effect periodic deviations in, calculation of, 16: 25954 (TID-16225)
ELECTRIC INSULATORS
bibliography on radiation effects on, 16: 25846 (NP-11929)
electric conductivity during reactor irradiation, device for measurement, 16: 25582
magnetic properties of, basic research on, 16: 25838(R) (ARF-1184-5)
radiation effects on organic, electron, 16: 25855
ELECTRIC POTENTIAL
charged particle diffusion in parabolic well, 16: 25885 (GEST-2002)
determination in metallic spheres in interplanetary space, 16: 26050
ELECTRIC POWER
bibliography on unconventional sources, 16: 25095 (SB-484)
generation by direct conversion and fusion devices, review, 16: 25089
production for space vehicles, parametric study, 16: 26629(R) (NP-11728)
ELECTROCHEMICAL ANALYSIS
use of stripping in, for iodide with silver microelectrodes, 16: 25279
ELECTROMAGNETIC FIELDS
effects on personnel testing and tuning radio engineering instruments, 16: 25662(T) (JPRS-13691(p.20-4))
interaction with plasma, 16: 26051
ELECTROMAGNETIC WAVES
bibliography, 16: 25959(T) (JPRS-13656(p.1-91))
effects of strong, on atoms and electrons, 16: 26183
emission by plane layers of turbid media, 16: 26425
frequency, effects of magnetic field, 16: 25877(R) (ANL-6534)
interactions with electron beams in anisotropic dielectric, 16: 25963(T) (JPRS-13656(p.193-218))
production and propagation in plasma, 16: 26401 (JINR-P-917)
production in high-altitude explosions, at 10 to 100 Mc, 16: 25636
propagation in magnetized ferrites between parallel planes, mathematical analysis, 16: 26399 (AD-270635)
propagation in plasma, thermal effects on dispersion relations, 16: 26398 (AD-270033)
theory of surface, use of surface impedance concept in, 16: 25959(T) (JPRS-13656(p.1-91))
ELECTRON BEAMS
alinement systems for, design of anastigmatic, 16: 25580
behavior and theory of high-energy bunched, summary report, 16: 26368 (AFOSR-2580)
depth dose and isodose curves for 10- to 35-Mev betatron, 16: 25189
dynamics in linear accelerators, graphic calculations for focusing, 16: 26382(T) (FTD-TT-61-242(p.43-5))
focusing in linear accelerators by periodic magnetic fields, 16: 26380(T) (FTD-TT-61-242(p.33-6))
focusing in linear accelerators, 16: 26381(T) (FTD-TT-61-242(p.37-42))
interactions with plasma, energy losses with radiation of longitudinal waves in, 16: 25961(T) (JPRS-13656(p.164-76))
interactions with electromagnetic waves in anisotropic dielectric, 16: 25963(T) (JPRS-13656(p.193-218))
interactions with plasma, hydrodynamic approximation, 16: 26424
oscillations in, radiation effects on, 16: 26393
production and properties, for therapeutic use, 16: 25188
radial oscillations in linear accelerators, 16: 26378(T) (FTD-TT-61-242(p.3-21))
reactions with aluminum and silver foils, gamma spectra from, 16: 26315
reactions with plasma; hot dense plasma production from, 16: 26417
use in heating materials, 16: 26065 (AFCRL-975)
ELECTRON LENSES
design of anastigmatic, 16: 25580
ELECTRON TUBES
development of materials for, 16: 25544(R) (AFCRL-62-2)
ELECTRONIC EQUIPMENT
description for measurements of ionospheric electron density, 16: 26001
ELECTRONICS
summary of quantum and solid state studies, 16: 26368 (AFOSR-2580)
ELECTRONS
binding by atoms and molecules, coefficients and cross sections for, 16: 26030
bremsstrahlung emission of longitudinally polarized, effects of nuclear charge density on, 16: 26348
capture and oscillations during betatron injection, 16: 26385(T) (FTD-TT-61-242(p.111-28))
capture by helium ions in reactions with atoms at 300 to 1500 kev, 16: 26021
capture in betatron and synchrotron acceleration, theory, 16: 26384(T) (FTD-TT-61-242(p.54-110))
concentrations and oscillations in plasma, 16: 26411
density in parabolic electric potential well, 16: 25885 (GEST-2002)
depolarization of transversely polarized, 16: 26178
electromagnetic-wave gradient effects on, 16: 26183
emission from metals, calculation of periodic deviations from Schottky effect in, 16: 25954 (TID-16225)
energy distributions in weakly ionized air, 16: 25989
field theory (self-consistent) for, in solids, 16: 26015
interactions with positrons, 16: 25906 (LNF-62/37(p.166-79))
interactions with phonons in crystals, expectation value for, 16: 26012
interactions with positrons, lepton production and decay from, 16: 26185
measurement in ionosphere, by r-f dispersion methods, 16: 26001
model for systems of, localized group, 16: 26119
motion in cyclotrons, effects of scattering fields, 16: 26391(T) (FTD-TT-61-242(p.167-82))
motion of relativistic, in magnetic fields, 16: 26394
motions in gases, 16: 26034
oscillations in plasma, theory of Landau damping, 16: 26413
polarization in mesons (μ^+) decay, 16: 26177
quantum-electrodynamic wave equations for systems of many, 16: 26003
radiation effects at 1 Mev on solar cells, 16: 25845(R) (NP-11759)
reactions with atoms and molecules, 16: 26035
reactions with atoms and molecules, excitation and ionization cross sections for, 16: 26036
reactions with crystal structure, relation to superconductivity, 16: 25987
reactions with hydrogen, ion production in, 16: 25955 (UCRL-6925)
reactions with molecules, mass spectra calculations by critical slope method, 16: 25320 (TID-16157)
recombination with cations, 16: 26031
scattering by atoms, molecules, and potential fields, elastic, 16: 26033
scattering by atoms at 10 to 80 kev, differential cross sections and excitation of bound states in, 16: 26237
scattering by diamond at 1 Bev, quasi-monochromatic bremsstrahlung from, 16: 26136
spectral functions for propagators of, in quantum electrodynamics, 16: 26100
spin exchange in molecule reactions, free-radical hyperfine structure from, 16: 25986
storage rings for, 16: 25905 (LNF-62/37(p.161-5))
trapping in water vapor, quasi-, 16: 25973
wave equations in gravitational fields for, 16: 25991
ELEMENTARY PARTICLES
book: *The Theory of Fundamental Processes*, 16: 26453

collective-variable canonical conjugate momenta in many-body systems, 16: 26173
decays in helium-3 (liquid), 16: 25983
equation of state for many-body systems of, with square-well potentials, 16: 26168
gravitational wave emission by, 16: 26176
interaction amplitudes at high energies and fixed angles, asymptotic, 16: 26446
interaction trajectories, slopes of Pomeranchuk, 16: 26122
interactions at high energies, Regge pole analysis, 16: 26154
interactions at high energies, cross sections, 16: 26447
interactions at 1 Bev, angular distribution and cross sections for, 16: 26071 (JINR-P-817)
interactions in universal Fermi theory, avoidance of unwanted leptonic, 16: 26109
interactions, nonrelativistic diagram analytic properties for, 16: 26186
interactions of spin-zero, production of polarized meson (pseudovector and vector) beams in, 16: 26124
interactions, one-meson (π) exchange non-static effects in, 16: 26166
interactions, order-disorder models for long-range, 16: 26125
interactions, properties of resonance, 16: 26158
interactions, resonance properties from, 16: 26187
interactions, theory of weak, 16: 26067 (CERN-62-17)
interactions, unitary symmetry properties of strong, 16: 26156
interactions, unrenormalized theories, 16: 26079 (JINR-P-964)
interactions, weak, 16: 25928 (NP-11977(p.71-7))
model for strong interactions, with nonelementary photons, 16: 26139
models for resonances of, review, 16: 26155
photoproduction dispersion relations, contribution from unobserved region, 16: 26073 (JINR-P-904)
production of neutral, quantum numbers from antiproton-proton annihilation, 16: 26121
quantum field theory of, dynamical-law formulation for systems, 16: 26438
scattering by nuclear emulsions, effects of higher order differences in measurements on reduction of spurious, 16: 26090 (NYO-10233)
scattering, effects of asymptote of Regge-type on high energy elastic, 16: 26070 (JINR-E-991)
strangeness considerations in weak leptonic and non-leptonic interactions, 16: 26099
theory, survey of geometrodynamics, quantum geometry, and spinors, 16: 26066 (ARL-62-332)
velocity of, determination using bubble chambers, 16: 25921 (NP-11977(p.45-48))
wave equations for particles with spin 0 and 1, Kemmer Algebra and Foldy-Wouthuysen transformations for, 16: 26088 (NP-11781)

ELEMENTS
radioinduced heating by thermal neutron reactions, 16: 26231 (TRG-Report-322)
synthesis mechanisms in stars, 16: 26341

ELK RIVER POWER REACTOR
electric installations and power-producing systems for, 16: 26608

EMBRYOS
effects of irradiation of, on adult life expectancy and pathology in mice, 16: 25177(R) (TID-16129)
radiation effects on DNA and RNA content in chick, gamma and x, 16: 25207
radiation effects on abortion and stillbirth in Japanese workers, 16: 25214
radiation effects on eyes in developing mouse, 16: 25215
radiosensitivity of rat, 16: 25231

EMISSIVITY
measurement, equipment design for, 16: 25761(R) (PWA-2088)

ENZYMES
radiotherapy effects on plasmin activity in cancer patients, effects of ϵ-aminocaproic acid on, 16: 25161

ERBIUM
crystal structure, magnetic energy effects on, 16: 25801
determination in uranium, spectrographic and spectrophotometric, 16: 25266 (CNEN-135)
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)

ERBIUM COMPLEXES
with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, synthesis, 16: 25321(R) (TID-16224)

ESCHERICHIA COLI
radiation effects on DNA from, 16: 25218

ESTERS
solvent properties for uranium in dilute carbonate media, 16: 25487

ETHANE
deuterium isotope effects on bond length in, 16: 25348 (IS-454)
radiolysis of solid by photons, 16: 25437

ETHANE, BROMO-
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)

ETHANE, CHLORO-
radiolysis of gaseous, molecular processes in, 16: 25419(R) (RRL-84)

ETHANE, DIBROMO-
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489

ETHANE, IODO-
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
photolysis of gaseous, 16: 25419(R) (RRL-84)
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)

ETHANE, TRICHLORO-
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)

ETHANETHIOL, 2-AMINO-
protective effects against radiation injuries in mice, 16: 25253
protective effects against radiation injuries to nucleic acid metabolism in mice, 16: 25255

ETHANOL
potentials of nickel electrode in, 16: 25322 (TID-16292)
radiolysis, hydrogen yields in, 16: 25419(R) (RRL-84)
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354

ETHYL ETHER
heat transfer in boiling, electroconvection effects on, 16: 25533

ETHYLENE
fragmentation, comparison of theory and experiment, 16: 25877(R) (ANL-6534)
radioinduced polymerization rates and yields, 16: 25409 (BNL-740)

ETHYLENE GLYCOL
drop coalescence at planar interface with benzene, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
radiation effects on aqueous solutions of polyoxy-, 16: 25447
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354

ETHYLENE POLYMERS
meson (π^-) capture, charge exchange in, 16: 26190
radioinduced crosslinking, effects of polyfunctional monomers on, 16: 25418(R) (RAI-306)
radioinduced crosslinking by ultraviolet light in presence of sensitizers, 16: 25455

ETHYLENE, TETRAFLUORO- POLYMERS
radiation effects on engineering properties, 16: 25843 (NARF-62-5T)
radiation effects on dynamic properties, 16: 25853(R) (TID-16273)
radiolysis, recombination of alkylfluoride and peroxide radicals from, 16: 25460

ETHYLENE, TRICHLORO-
heat transfer in boiling, electroconvection effects on, 16: 25533

ETHYLENEDIAMINE
electric conductivity and spectra of alkali metals in, 16: 25357

EUROPIUM
crystal structure, magnetic energy effects on, 16: 25801
determination in yttrium and samarium oxides, activation, 16: 25292
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351

EUROPIUM COMPLEXES

with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, synthesis, 16: 25321(R) (TID-16224)
EUROPIUM IONS
solvent partition of trivalent, in tributylphosphate systems, 16: 25489
EUROPIUM ISOTOPES Eu-153
neutron capture cross sections at 10^5 to 10^8 ev, 16: 26518
EUROPIUM NITRATES
solvent extraction by tributylphosphate, effects of diluents on, 16: 25489
EUROPIUM OXIDES
thermodynamic properties, 16: 25386
EXPERIMENTAL BOILING WATER REACTOR
development, 16: 26455(R) (ANL-6573)
EXPERIMENTAL BREEDER REACTOR
development, 16: 26455(R) (ANL-6573)
stability Mark I, II, and III, 16: 26558
EXPERIMENTAL BREEDER REACTOR-II
development, 16: 26455(R) (ANL-6573)
stability of, 16: 26560
EXPLOSIONS
deformations near ground surface by 100-ton TNT, 16: 25087 (NP-11817)
EXPLOSIVES
blast and radiation effects on ordnance material exposed to atomic bomb detonation, 16: 25088 (PA-TR-1690)
radiation effects, gamma, 16: 25858
EXPONENTIAL PILES
design studies, 16: 26469 (JEN-89-DF/I-28)
lattice parameters of Marius, 16: 26063 (CEA-2157)
EXTRUSION
development, 16: 25733(R) (MAB-139-M(F4))
EYES
radiation effects of radium on cornea and sclera of, in rabbit, 16: 25185
radiation effects of radium on optic nerve, retina, and uvea of, in rabbit, 16: 25186
radiation effects of radium on lens of, in rabbits, 16: 25187
radiation effects on, of developing mouse embryos, 16: 25215

F

FALL-OUT
bibliography on radioactive, 16: 25617 (TID-3086(Suppl.1))
contamination of Quartermaster Corps clothing and packaging materials, 16: 25656 (USNRDL-TR-557)
monitoring in Alaska, 1960, 16: 25149(R) (HW-72500(p.165-9))
monitoring in Canada, Jan.–March 1962, 16: 25616(R) (NP-11914)
monitoring in Cracow, Poland, Jan. through Mar. 1960, 16: 25620
monitoring in Denmark, 1961, 16: 25169 (RISÖ-41)
monitoring in Germany, 1961 and 1962, 16: 25167(R) (NP-11884)
monitoring in Great Britain, 1961, 16: 25168 (NP-11904)
monitoring in Mexico, Feb. 1959 to Oct. 1961, 16: 25674
monitoring in the SM-1 area, summary for 1½ yrs prior to reactor startup to 3 yrs after, 16: 25646(R) (ERDL-1691-TR)
monitoring, survey of world-wide operations, 1961, 16: 25649 (HASL-128)
plutonium distribution in man and animals, 16: 25171
FAST NEUTRON CROSS SECTIONS
calculation above 1 kev, 16: 26517 (TID-13526)
measurement, correlation to integral experiments, 16: 26532 (BNL-5604; BNL-5892)
FAST NEUTRONS
capture, two-group calculation of gamma radiation from, 16: 26202(T) (AEC-tr-5077)
detection and measurement using threshold detectors, 16: 26530
detection, proportional detector for, 16: 26204(T) (AEC-tr-5217)
flux propagation in fast reactors, measurement of long-range, 16: 26531
reactions (n,α) and (n,p) with silicon-28 and 29, spectra from, 16: 26306
reactions with reactor fissile, fertile, and structural materials, 16: 26505 (TID-13546)
research program in the United Kingdom, 16: 26504
scattering by light nuclei in fast reactors, resonance, 16: 26521
scattering by nuclei at 3.4 to 4.6 Mev, angular distributions, 16: 26507
spectra in Russian BR-5, 16: 26204(T) (AEC-tr-5217)
FAST REACTORS
behavior of breeder-type, for long periods, 16: 26540
calculation methods for, 16: 26536
characteristics of power, 16: 26551
characteristics of ceramic and cermet systems, 16: 26552
characteristics of coupled fast-thermal steam superheating system, 16: 26553
conference on physics of, 16: 26503 (STI/PUB/49(Vol.I))
conference on physics of, 16: 26535 (STI/PUB/49(Vol.II))
conference on physics of, 16: 26554 (STI/PUB/49(Vol.III))
design and characteristics of, 16: 26567
design and operation of Russian pulsed, 16: 26570
design of RAPSODIE, 16: 26569
development of British, review, 16: 25082 (DPR/INF/267)
Doppler effect in oxide-type, calculation and significance for reactor safety, 16: 26561
Doppler effect of plutonium-239 in, 16: 26562
effective lifetime and temperature coefficient in coupled fast-thermal systems, 16: 26556
evaluation of uranium-233–thorium breeder, 16: 26613 (NDA-2164-3)
fission product in burnup, 16: 26548
fuel elements, core support structure for, 16: 26579(P)
fuel for, evaluation of plutonium, 16: 25697 (GEAP-3876)
integral experiments on plutonium, thorium, and uranium fast systems, 16: 26522
multi-group calculations for, 16: 26537
neutron cross section measurements in, 16: 26506
neutron cross-section error effects on large, dilute, 16: 26542
neutron flux propagation in, measurement of long-range, 16: 26531
neutron group cross sections for, 16: 26519
neutron scattering by light elements in, resonance, 16: 26521
performance, effects of plutonium isotopic composition on, 16: 26549
performance of large power-type, effects of higher isotopes, recycling, and fission products, 16: 26550
reactivity coefficients of sodium in, 16: 26545
reactivity, effects of hydrogen on, 16: 26544
reactivity, influence curves for calculation of structural distortion effects, 16: 26555
safety analyses of experimental zero-power, 16: 26565
safety in, melt-down studies in transient reactor tests, 16: 26564
safety, review of nuclear aspects in, 16: 26563
safety studies at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
stability and transient operation of, 16: 26559
FATIGUE
testing equipment and methods for low-cycle, review, 16: 25606 (TID-15356)
testing equipment for low-cycle, 16: 25607
FATTY ACID ESTERS
analysis for carbon-14 and tritium using ionization chambers, 16: 25428
intestinal absorption in patients irradiated with cobalt-60 in abdominal pelvic region, 16: 25230
FATTY ACIDS
extracts from irradiated rabbits, effects on succinic dehydrogenase activity in cancerous and normal mice livers, 16: 25224
extracts from irradiated rabbits, effects on succinic dehydrogenase activity in Yoshida sarcoma cells, 16: 25225
extracts from irradiated rabbits, effects on DNA and mitosis in transplanted Yoshida sarcomas, 16: 25228
FERMIUM
separation from americium and curium by solvent extraction using 2-ethylhexylphenylphosphonic acid, 16: 25477 (ORNL-3273)
FERMIUM ISOTOPES Fm-254
energy levels of, from Einsteinium-254 decay, 16: 26289
FERRATES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
FERRITES
electromagnetic wave propagation in magnetized, between conducting parallel planes, 16: 26399 (AD-270635)
FERROMAGNETIC MATERIALS
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
magnetization measurements in, pulsed-field, 16: 25882 (ASD-TR-61-630)
neutron scattering by, polarized, 16: 26188
nuclear spin dynamics in, 16: 26013

ultrasonic wave interactions in, 16: 25882 (ASD-TR-61-630)
FETUSES
effects of radiation on developing, 16: 25175 (TID-16051)
radiation effects after male exposure, protective effects of S-β-aminoethylisothiuronium against, 16: 25211
radioinduced chromosome aberrations in brain and lung tissue in human, 16: 25181(R) (TID-16317)
FIELD THEORY
annihilation and production operator commutation relations, generalization of, 16: 26443
elementary particle models in, review, 16: 26155
elementary particle strong interactions in, unitary symmetry effects in, 16: 26156
hamiltonian formalism consistency, true-variable definition, 16: 26451
operators of proper homogeneous Lorentz group in, 16: 25966
photon noselementarity in S-matrix theory, 16: 26139
propagators with singularities at zero coupling, derivation, 16: 26442
quantum, Lorentz formulations using stochastic observers, 16: 26444
quantum theory of, dynamical-law formulation, 16: 26438
regularization method in, 16: 26434 (JINR-E-977)
self-consistent, for electrons in solids, 16: 26015
solutions in Yang-Mills, isotopic gauge transformations in static and spherically-symmetric, 16: 26449
spectral representation of the two-point function in quantum, 16: 26057
survey of geometrodynamics, quantum geometry, and spinors, 16: 26066 (ARL-62-332)
universal Fermi interaction in, rotational symmetries, 16: 26109
vertex function analytic properties, relation to mass spectral condition, 16: 26450
FIRES
in shipments of radioactive materials, methods of fighting, 16: 25669
FISH
infection with *Chondrococcus columnaris*, in Columbia River, 1960 and 1961, 16: 25145(R) (HW-72500(p.151-5))
influx of strontium across gills, tracer study, 16: 25116(R) (HW-72500 (p.23-5))
radiosensitivity of reproductive cells in rainbow trout, 16: 25213
salmon spawning in Columbia River, 1961, 16: 25144(R) (HW-72500 (p.148-50))
strontium-90 and yttrium-90 distribution and retention in trout, 16: 25117(R) (HW-72500(p.26-9))
toxic effects of reactor effluent in young salmon, 16: 25143(R) (HW-72500(p.144-7))
FISSION
model of, nuclear shapes in quasistatic, 16: 26358
FISSION CHAMBERS
test specification for, 16: 25541 (AEEW-R-107)
FISSION PRODUCTS
absorption by man, permissible limits for, 16: 25643 (CEA-2163)
activity in loop in Mol from graphite-uranium carbide elements, 16: 26498(T) (AEC-tr-5212)
analysis of gaseous, 16: 25295
burnup in fast reactors, 16: 26548
conference on nuclear reactor chemistry, Gatlinburg, Tenn., October 10 to 12, 1961, 16: 26472 (TID-7622)
content in coolant of Shippingport Pressurized Water Reactor, 16: 26599 (WAPD-PWR-TE-79)
content in SM-1 coolant, 16: 26490 (TID-7622(p.236-42))
detection and measurement using superconducting-film detector, 16: 25590
detection in reactor coolants, Cherenkov detector, 16: 25598(P)
diffusion from uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
metabolism by arctic plants and animals, 16: 25149(R) (HW-72500 (p.165-9))
migration in soils, 16: 26636(R) (EURAEC-84)
recoil release from ceramic fuel elements, 16: 26487 (TID-7622(p.193-206))
release by thorium and uranium carbide–graphite matrix fuels, 16: 26486 (TID-7622(p.171-92))
release from defective sheathed ceramic fuel elements, 16: 26485 (TID-7622(p.160-70))
release from fuel element claddings, 16: 25750(R) (BMI-X-196)
release from uranium dioxide by diffusion, melting, and oxidation, 16: 26484 (TID-7622(p.149-59))
release on in-pile melting of reactor fuels, 16: 26488 (TID-7622(p.207-15))
separation from heavy water in slurry type reactor by distillation, 16: 25496(P)
separation from thorium and uranium by solvent extraction, improvement of process for, 16: 25494(P)
thermodynamic properties in bismuth solutions, 16: 25391
trapping system for HTGR, computer program for analysis of transient performance of, 16: 26593 (GAMD-3168)
vitrification of concentrated solutions, 16: 26634 (CEA-2130)
FISSIONABLE MATERIAL
container design, IAEA safety requirements, 16: 25672
FLORIDA POWER REACTOR
design and development, 16: 26595(R) (GNEC-82)
FLUID FLOW
control in ducts, device, 16: 25538(P)
heat and mass transfer in, through fixed and fluidized beds, 16: 25532
in pipes and rectangular channels, equations for friction factors for, 16: 26470 (KAPL-2000-18)
limits in vertical pipe of countercurrent, 16: 25518 (AEEW-R-142)
metering technique for, development of new, 16: 25521 (ARF-1167-18)
of air-water mixtures in vertical rectangular channel, 16: 25528 (WAPD-T-1502)
pressure drop in two-phase annular, measurement techaique development, 16: 25520 (AERE-R-3921)
stability analysis of hydraulic, computer program for, 16: 26470 (KAPL-2000-18)
stability of viscous, between rotating cylinders, 16: 25537
thermal transport equations for, methods of solution, 16: 25524 (KAPL-2206)
FLUID FLOW (TURBULENT)
in circular tubes, velocity profiles and theoretical characteristics, 16: 25529(T) (AEC-tr-5214)
FLUIDS
distribution functions in classical, approximations of pair, 16: 26445
FLUORESCENCE
yields at 5 to 12 kev, measurements of K-shell, 16: 26000
FLUORIDES
separation from beryllium by solvent extraction with amines, 16: 25475 (NCL/AE-172)
FLUORINE
meson (π^-) reactions at 2.8 Bev, K^0 and Λ^0 production in, 16: 26189
neutron capture cross sections, 16: 26509
production, design and operation of pilot plant for, 16: 25314 (KY-399)
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
FLUORINE ISOTOPES F-17
energy level parameters for, 16: 26324
FLUORINE ISOTOPES F-18
chemical behavior of oxygen-16(t,n)-produced, 16: 25432
recoil range from alpha reactions (α,n), 16: 26243
FLUORINE ISOTOPES F-19
deuteron reactions (d,p), resonances and stripping reduced widths in, 16: 26339
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
neutron activation cross sections at 14.7 Mev, 16: 26268
FLUORINE ISOTOPES F-20
energy levels from deuteron reactions (d,p) with fluorine-19, 16: 26339
half life, 16: 26213 (AE-78)
FLUOROCARBONS
preparation and properties for use in reactor technology, 16: 26480 (TID-7622(p.109-20))
radiolysis, comparison with hydrocarbons, 16: 26480 (TID-7622(p.109-20))
FOOD
absorption of cesium-137 and strontium-90 by cultivated, 16: 25642 (CEA-2159)
bibliography on packaging requirements for radiosterilized, 16: 25681 (TID-15144)

bibliography on preservation by irradiation, 16: 25685 (SB-403(Rev.))
radiosterilization, effects on survival of spores of *Clostridium botulinum*, 16: 25172(R) (NP-11726)
FORGING
development, 16: 25733(R) (MAB-139-M(F4))
FORMIC ACID
decomposition, catalytic effects of doped germanium, 16: 25355
FRACTURE TESTS
for metals under impulsive loading conditions, 16: 25759 (NP-11890)
FREE RADICALS
electron spin resonance, hyperfine structure exchange relaxation in, 16: 25986
photo-ionization of alkyl at 7.2 to 11.7 Mev, 16: 25435
recombination of alkylfluoride and peroxide, in irradiated teflon, 16: 25460
FROGS
radiation effects on heartbeat, 16: 25216
FUEL CELLS
bibliography on, 16: 25915 (NP-11936)
properties and prospective electric-power uses, review, 16: 25089
FURNACES
development for studies of fission product retention by graphite reactor fuels, 16: 26486 (TID-7622(p.171-92))
FUSED SALTS
statistical thermodynamics, 16: 25390
surface tension, equations and correlation functions for, 16: 26482 (TID-7622(p.128-36))

G

GADOLINIUM
crystal structure, magnetic energy effects on, 16: 25801
determination in uranium, spectrographic and spectrophotometric, 16: 25266 (CNEN-135)
determination in yttrium and samarium oxides, activation, 16: 25292
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
magnetocrystalline anisotropy, 16: 25882 (ASD-TR-61-630)
neutron capture cross sections, 16: 26509
poisoning efficiency in radiochemical processes, 16: 25415 (ORNL-3309)
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
GADOLINIUM COMPLEXES
with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, synthesis, 16: 25321(R) (TID-16224)
GADOLINIUM ISOTOPES Gd-153
separation from terbium-161 using Dowex-50 resin, 16: 25445
GADOLINIUM ISOTOPES Gd-159
decay scheme, 16: 26293
GADOLINIUM OXIDES
thermodynamic properties, 16: 25386
GADOLINIUM SULFATES
specific heat at 0.05 to 4.0°K, 16: 25367
GALLIUM
determination in aluminum, activation, 16: 25288
determination in gallium arsenides by neutron activation, 16: 25293
fluorescence, K-shell yields, 16: 26000
properties, theory of infrared and optical, 16: 25758 (NP-11675)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
GALLIUM ARSENIDES
analysis for impurities from fused quartz reaction vessels by neutron activation, 16: 25293
GALLIUM ISOTOPES Ga-66
recoil range from alpha reactions (α,n) in copper, 16: 26243
GALLIUM ISOTOPES Ga-72
energy levels and gamma spectra, 16: 26254
GALLIUM ISOTOPES Ga-74
decay scheme, 16: 26283
GALLIUM–URANIUM ALLOYS
thermodynamic properties at 450°C, 16: 25397
GALLIUM–VANADIUM ALLOYS
thermodynamic properties of superconducting, 16: 25804
GAMMA DECAY
by spherical nuclei, analysis of collective E3 and E4, 16: 26271
GAMMA RADIATION
absorption by impurity atoms in host crystals, probabilities for recoilless, 16: 26316
absorption ($0 \rightleftharpoons 0$) transition measurements, 16: 26311
attenuation by concrete, 16: 25415 (ORNL-3309)
detection and measurement, performance of broad range chemical dosimeter, 16: 25561 (NDL-TR-7)
detection and measurement, circuit design and performance of portable radiac, 16: 25572 (USNRDL-TR-567)
detection and measurement, frequency response of current ion chamber for, 16: 25587
dosage in Japan from natural radionuclides, 16: 25675
effects on DNA and RNA content in chick embryo, 16: 25207
effects on DNA and RNA in liver and spleen, 16: 25208
effects on ferroelectric parameters of guanidinium aluminum sulfate crystals, 16: 25456
effects on image orthicon and vidicon camera heads, 16: 25836 (AD-270724)
effects on immunogenic properties of Sarcoma I ascites tumor, 16: 25108
effects on intestinal absorption of fats in patients treated with cobalt-60, 16: 25230
effects on nervous system of rats, prenatal exposure, 16: 25239
effects on nucleic acid metabolism in mice, 16: 25212
effects on Yoshida ascites sarcomas in rats, 16: 25220
energy and time dependence of delayed, from fission, 16: 26222 (LAMS-2647)
genetic effects in human fetal brain and lung tissue, 16: 25181(R) (TID-16317)
heating effects on materials, design of calorimeter for measuring, 16: 26502
intensity from fast and thermal neutron capture, two-group approximation, 16: 26202(T) (AEC-*tr*-5077)
production and escape in reactors, computer code for, 16: 26466 (GEMP-123)
reactions (γ,n) with nuclei to 23 Mev, neutron yields from, 16: 26357
reactions (γ,p) with nuclei at (0.5 to 2.0) × 10^8 °K at 10^{-5} to 10^5 gm cm^{-3}, rates of, 16: 26341
reactions (γ,p) with lithium-7 at 12 to 16 Mev, proton spectra from, 16: 26353
reactions with nuclei, boson production cross sections for, 16: 26362
spectra from charged-particle reactions with aluminum and silver foils, 16: 26314
spectra from electron reactions with aluminum and silver foils, 16: 26315
spectra from lithium-6 and 7 reactions with lithium-6 and 7 at 2.5 to 2.75 Mev, 16: 26325
GAMMA SPECTRA
production of quasi-monochromatic, by 1-Bev electron reactions on diamond, 16: 26136
GAMMA SPECTROMETERS
design and performance of scintillation, 16: 25549 (ASD-TDR-62-52)
GAMMA SPECTROSCOPY
data analysis techniques for scintillation, 16: 25556 (IDO-16784)
GAS COOLED REACTORS
carbon transport problems in graphite, 16: 26473 (TID-7622(p.1-23))
design concepts of heavy water-moderated pressure-tube, 16: 26594 (GNEC-74)
development of British, review, 16: 25082 (DPR/INF/267)
fuel rod assembly design, 16: 26573(P)
moderator thermal characteristics, graphite, 16: 25534 (BNL-5522)
pressure vessel design and construction for large, 16: 26497 (TID-16138)
seals for use on compressors and turbines, potential of visco, 16: 25506 (TID-15987)
shock absorber for falling fuel elements and control rods, 16: 26572(P)
GAS FLOW
atomic properties at high temperatures and velocities, 16: 26029
GAS–LIQUID SYSTEMS
flow in vertical rectangular channel, annular, 16: 25528 (WAPD-T-1502)
GASEOUS DIFFUSION PLANTS
concentration control in, for uranium isotope separation, 16: 25686 (CEA-2160)

monitoring at Paducah, 1961, 16: 25653 (KY-419)
GASES
analysis for short-lived fission products, spectrometric, 16: 25295
deposition, conference, Columbus, Ohio, Nov. 1961, 16: 25308 (DMIC-170)
electric conductivity and electron distribution of slightly ionized, theory, 16: 25951 (R62SD64)
electron and ion motions in, slow, 16: 26034
internal energy relaxation in, 16: 26044
nonbonding interactions in, at high temperatures, 16: 25875 (AFSWC-TDR-62-21)
pumping by absorption into liquid gettering material, 16: 25603(P)
purification of inert, for nuclear technology uses, 16: 25517
reactions with atomic, ion, and molecular beams at high energies, 16: 26041
reactions with atomic and ion beams above 0.2 kev, electron capture and loss in, 16: 26043
representations of systems of dipoles and ions, classical theory, 16: 26019
separation from graphite, effects of temperature and time, 16: 26474 (TID-7622(p.24-34))
thermodynamic properties at high temperatures, calculation, 16: 25875 (AFSWC-TDR-62-21)
thermodynamic properties at high temperatures and pressures, effects of intermolecular interactions on, 16: 25875 (AFSWC-TDR-62-21)
GENETICS
heterozygote formation in *Hemophilus influenzae*, 16: 25152(R) (TID-16075)
radiation effects on mouse populations, 16: 25182(R) (TID-16323)
GEOLOGY
age estimation by lead/uranium method, 16: 25626
mapping of thorium and uranium content in rocks in New Hampshire, 16: 25618(R) (TID-15225)
GEOMAGNETIC FIELDS
cosmic radiation intensity variations in, 16: 26053
GERMANIUM
catalytic effects on decomposition of formic acid and deuterium-hydrogen isotope exchange, 16: 25355
neutron capture cross sections, 16: 26509
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
GERMANIUM CRYSTALS
neutron reactions, electric conductivity and thermoelectric power from fast, 16: 25852 (PAN-318/I-B)
radiation damage study of electric conductivity, Hall coefficient, and thermoelectric power, fast neutron, 16: 25849 (PAN-314/I-B)
radiation effects on, lattice defects from neutron, 16: 25850 (PAN-315/I-B)
radioinduced dislocations in, recombination of neutron, 16: 25851 (PAN-316/I-B)
GERMANIUM ISOTOPES Ge-74
energy levels and gamma spectra, 16: 26283
GERMANIUM ISOTOPES Ge-75
electron conversion coefficients and neutron activation cross sections for metastable, 16: 26351
GERMANIUM ISOTOPES Ge-77
electron conversion coefficients and neutron activation cross sections for metastable, 16: 26351
GERMANIUM–THORIUM ALLOYS
crystal structures and phase studies of $Th_{0.7}Ge_3$ and $ThGe_2$, 16: 25771
GERMANY
fall-out monitoring, 1961 and 1962, 16: 25167(R) (NP-11884)
GLASS
adsorptive properties for cadmium, 16: 26009
beta recoil of bismuth-212 and -214 from, 16: 26009
decontamination by removal of iron-59 activity, evaluation of wetting agents for, 16: 25660(T) (JPRS-13691(p.8-12))
development of fuel-bearing, 16: 26477 (TID-7622(p.74-85))
preparation of plutonium-bearing, 16: 26478 (TID-7622(p.86-97))
thermal desorption energies for bismuth and lead, 16: 26009
vitrification of concentrated fission product solutions, 16: 26634 (CEA-2130)
GLUCOSE
radiation effects on oxidation in bacteria, protective effects of cysteine against, 16: 25223
GLUCURONIC ACID
protective effects against radiation injuries in mice, 16: 25253
GLUTATHIONE
protective effects against ultrasoft x-radiation damage to mast cells in rats skin, 16: 25206
protective effects against radiation injuries in mice, 16: 25253
GLYCOLYSIS
radiation effects combined with hematoporphyrin on, in cancer tissue in man, 16: 25234
GLYOXIME, DIMETHYL-
potentials of nickel electrode in, 16: 25322 (TID-16292)
GOLD
determination in gallium arsenides by neutron activation, 16: 25293
determination in Witwatersrand ores, radiochemical evaluation of errors in fire-assay, 16: 25635
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
neutron capture cross section, 16: 26505 (TID-13546)
neutron capture cross sections, 16: 26509
nitrogen-14 reactions, neutron transfer in, 16: 26221 (JINR-P-973)
properties, theory of infrared and optical, 16: 25758 (NP-11675)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
GOLD FOILS
optical emission of irradiated, 16: 25847 (ORNL-3114)
GOLD ISOTOPES Au-197
energy level strength functions for, 16: 26518
neutron reactions (n,α) at 14 Mev, cross sections and spectra from, 16: 26297
GOLD ISOTOPES Au-198
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
GOLD ISOTOPES Au-199
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
GOLD–MANGANESE ALLOYS
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
GOLD ORES
analysis for gold, radiochemical examination of errors in fire-assay, 16: 25635
GONADS
radiation effects on nucleic acid metabolism in mouse, gamma and x, 16: 25212
radiation effects on, protective effects of casein against, 16: 25233
radiation effects on nucleic acid metabolism in mouse, protective effects of AET and MEA against, 16: 25255
radiation exposure from iodine-131 deposition in bladder and stomach, 16: 25668
GRANITES
age estimation from beryllium and lithium contents, 16: 25630
analysis for cerium, lanthanum, neodymium, scandium, and yttrium, 16: 25287
geochemistry of Soviet thorium- and uranium-containing, 16: 25627
hafnium and zirconium contents, 16: 25629
GRAPHITE
bonding to beryllium oxide, development of brazing alloys and methods for, 16: 25739
degasification, effects of temperature and time, 16: 26474 (TID-7622 (p.24-34))
fabrication and production of pyrolytic, 16: 25728 (AD-270153)
pore structure, effects of nature of coke and pitch impregnations, 16: 25787
production of dense impermeable, 16: 25743(P)
production of impermeable, by impregnation, 16: 25742(P)
properties as fuel element material, 16: 25767(T) (AEC-tr-5211)
radiation effects on creep of springs, 16: 25870
radiation effects, 16: 26467(R) (HW-73100)
radioinduced energy storage in, effects of irradiation temperature, 16: 25864
reactions with nitrogen at 2300°K, 16: 25394

reactions with sodium vapor at 940°C, 16: 25318 (RAD-TM-60-44)
structure, 16: 25774
thermal characteristics of air-cooled channels of, 16: 25534 (BNL-5522)
thermal conductivity at 2000 to 3800°F, 16: 25753 (GAMD-2089)
thermal expansion of synthetic, at 80 to 2000°F, 16: 25773
GRAPHITE (IMPREGNATED)
production of impermeable, 16: 25742(P)
GRAPHITE MODERATED REACTORS
carbon transport problems in gas-cooled, 16: 26473 (TID-7622(p.1-23))
economics of low-power natural-uranium power, 16: 26607
moderator lattice properties, review, 16: 26063 (CEA-2157)
moderator thermal characteristics, 16: 25534 (BNL-5522)
GRASS
beta radioactivity and potassium content in, 16: 25644 (CLOR-9)
GRAVITATION
electron wave equations in, 16: 25991
wave emission by elementary particles, 16: 26176
GT. BRIT. ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, BERKS, ENGLAND
fall-out monitoring, 1961, 16: 25168 (NP-11904)
GRENOBLE REACTORS
design of Siloe, 16: 26622
GRENOBLE REACTORS (MELUSINE)
design and performance of, 16: 26622
GROUND
fall-out monitoring, Canada, Jan.–March 1962, 16: 25616(R) (NP-11914)
neutron flux at interface with air, Monte Carlo calculation of, 16: 26200 (ORNL-3287)
radioactivity from natural sources in Japan, 16: 25675
GROUND WATERS
contamination in waste disposal, 16: 25677
flow, electrical analog simulation, 16: 25613 (HW-73711)
flow velocity, tracer studies, 16: 26636(R) (EURAEC-84)
GUINEA PIGS
radiation injuries, protective effects of dry bone marrow injections on oxygen consumption in, 16: 25204

H

HAFNIUM
contents in granites and zircons, 16: 25629
contents in minerals and rocks, ratio to zirconium, 16: 25631
metallurgical effects on creep and tensile properties of aluminum-titanium alloys, 16: 25820
radiation effects on properties, testing PWR Core I control rod for, 16: 25854 (WAPD-TM-336)
separation from iron and zirconium by ion exchange, 16: 25278(T) (SCL-T-423)
HAFNIUM BORIDES
thermodynamic properties at 3000°K and in different atmospheres, 16: 25747 (ASD-TDR-62-204(Pt.I))
thermodynamic properties at 300 to 1200°K, 16: 25401
HAFNIUM CARBIDES
thermodynamic properties at 3000°K and in different atmospheres, 16: 25747 (ASD-TDR-62-204(Pt.I))
HAFNIUM FLUORIDES
heat of formation, measurement by combustion bomb calorimetry, 16: 25360
HAFNIUM ISOTOPES Hf-178
energy levels and gamma spectra, 16: 26254
HAFNIUM ISOTOPES Hf-180
decay scheme, 16: 26255
HAFNIUM–NICKEL ALLOYS
phase diagram, 16: 25819
HAFNIUM OXYFLUORIDES
hydrolysis products, composition, 16: 25326(T) (AEC-tr-5117)
HAFNIUM–OXYGEN SYSTEMS
thermodynamic properties of oxygen in, 16: 25384
HANFORD PRODUCTION REACTORS (K)
inlet and outlet nozzle assembly retaining rings, mechanism of failure in Truarc, 16: 26612 (HW-73643)
HANFORD WORKS, RICHLAND, WASH.
ground water flow, electrical analog simulation, 16: 25613 (HW-73711)
HEALTH PHYSICS
development in Japan, 16: 25084 (JAERI-7020)
integrated dose measurement by mechanographic methods, 16: 25550 (CEA-2128)
personnel-exposure and contamination control at the ORNL Research Reactor, 16: 25654 (ORNL-TM-278)
protection of industrial users of x radiation and sealed radioactive sources, 16: 25680
translation of selected papers from *Gigiyena i Sanitariya* (Hygiene and Sanitation), Vol. 27, No. 2, 1962, 16: 25659(T) (JPRS-13691)
HEART
contraction of ventricle, effects of calcium-45 and ouabain on, 16: 25107
radiation effects on beat, in frog, 16: 25216
HEAT-RESISTING ALLOYS
corrosion by alkali metals, review, 16: 25714 (DMIC-169)
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)
translation of selected articles on, 16: 25719(T) (FTD-TT-61-31)
HEAT TRANSFER
between uranium dioxide and Zircaloy-2, coefficient of, 16: 25523 (CRFD-1075)
burnout in steam-water systems in round tubes, 16: 25530(T) (EURAEC-42)
coefficient equation for nucleate boiling, from horizontal surface, 16: 25531
conference, Minsk, USSR, Jun. 1961, 16: 25527 (RM-2852-PR)
from internally heated thin bodies, convective and radiative, 16: 25536
in boiling liquids, electroconvection effects on, 16: 25533
in eccentric annuli, 16: 25526 (NYO-9649)
through fixed and fluidized beds, 16: 25532
to air from graphite channels, 16: 25534 (BNL-5522)
transport equations for, method of solution, 16: 25524 (KAPL-2206)
HEAT TRANSFER SYSTEMS
design, 16: 26603(T,R) (EURAEC-36)
design for studies of potassium–sodium alloys (liquid), 16: 25535
development of loops, 16: 26604(T,R) (EURAEC-38)
HEAVY WATER REACTORS
coolant loss, computer analysis of behavior in, 16: 26587 (CVNA-117 (Vol.I))
design concepts of gas-cooled pressure-tube, 16: 26594 (GNEC-74)
fuel element development, 16: 25735(R) (NMI-7251)
operation of slurry type, separation of fission products from heavy water in, 16: 25496(P)
stability of boiling, 16: 26601(T) (AEC-tr-5078)
HELIUM
electron correlation and Hartree-Fock energies of $1s2s\ ^1S$ and ^3S states, 16: 26004
energy of liquid, variational calculation of ground-state, 16: 26007
hydrodynamic properties of II phase, 16: 25911 (NP-11813)
production by irradiation of beryllium oxide, method for measuring, 16: 26492 (TID-7622(p.254-62))
reactions with gases, ionization cross sections, 16: 26238
reactions with helium ions at 300 to 1500 kev, electron loss in, 16: 26021
separation from radioactive krypton and xenon by fixed-bed adsorption, 16: 26489 (TID-7622(p.218-35))
solubility in heavy water at high pressures and 50 to 280°C, 16: 25303 (BMI-1587)
spectra in sunlit aurorae, emission at 10830 Å, 16: 26002
stopping power for recoil ions from alpha reactions (α,n), 16: 26243
thermodynamic properties at high temperatures, review, 16: 25300 (ARL-62-358)
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
HELIUM IONS
mobility in helium-3 and -4 (liquid), relation to pressure and temperature, 16: 25984
reactions with atoms at 300 to 1500 kev, electron capture in, 16: 26021
HELIUM ISOTOPES He-3
elementary-particle decays in liquid, 16: 25983
ion mobility in liquid, relation to pressure and temperature, 16: 25984
nuclear polarization by optical pumping, 16: 26332

phase separation from about 0.066 at.% helium-4 near 0.15°K, 16: 25976
proton reactions, meson (π) production cross sections, 16: 26260
thermal capacity measurements at 0.06 to 1°K in, 16: 25981
HELIUM ISOTOPES He-4
crystal parameters of gamma-phase solid, 16: 25994
gamma reaction (γ,π), anisotropy in distribution from, 16: 25888 (LNF-62/37(p.10-13))
ion mobility in liquid, relation to pressure and temperature, 16: 25984
phase separation at about 0.066 at.%, from helium-3 near 0.15°K, 16: 25976
thermal capacity measurements at 0.06 to 1°K in, 16: 25981
vapor pressure and liquid-vapor equilibrium in, 16: 26006
HELIUM ISOTOPES He-6
half life, 16: 26213 (AE-78)
HEMATOLOGY
design of automatic blood cell scanner, 16: 25568 (NYO-9644)
HEMATOPOIETIC SYSTEM
morphological effects of radioinduced lysolecithin on, 16: 25226
radiation effects on, in dogs and rabbits, 16: 25205
radiosensitivity, 16: 25191
radiosensitivity of antibody-forming cells, 16: 25109
HEMOLYSIN
injections from irradiated rabbit liver, histological effects of, 16: 25227
1,5-HEPTADIENE
separation from deuterated isomers by partition chromatography, 16: 25427
1,5-HEPTADIENE, 3-METHYL-
separation from deuterated isomers by partition chromatography, 16: 25427
HEPTANE
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
4-HEPTANOL, 2,6-DIMETHYL-
potentials of nickel electrode in, 16: 25322 (TID-16292)
HEXADECANE
radioinduced crosslinking by ultraviolet light in presence of sensitizers, 16: 25455
1,5-HEXADIENE
separation from deuterated isomers by partition chromatography, 16: 25427
HEXANE
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
heat transfer in boiling, electroconvection effects on, 16: 25533
radioinduced crosslinking by ultraviolet light in presence of sensitizers, 16: 25455
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
HEXANE, 3,4-DIMETHYL-
separation from deuterated isomers by partition chromatography, 16: 25427
1-HEXENE, 4-METHYL-
separation from deuterated isomers by partition chromatography, 16: 25427
HIGH-ALTITUDE EXPLOSIONS
electromagnetic wave production at 10 to 100 Mc, 16: 25636
HIGH TEMPERATURE GAS COOLED REACTOR EXPERIMENT
cost factors, 16: 26606
HOLMIUM
crystal structure, magnetic energy effects on, 16: 25801
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
HOLMIUM COMPLEXES
with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, synthesis, 16: 25321(R) (TID-16224)
HOLMIUM–IRON–MANGANESE ALLOYS
phase studies, Laves, 16: 25798
HOMOGENEOUS REACTOR TEST
operation, summary of run 2S, 16: 26618 (ORNL-TM-173)
HYDRIDES
preparation, properties, and uses of refractory-metal, 16: 25768(T) (NASA-TT-F-102)
HYDROCARBONS
radicals, electron spin resonance of transient, 16: 25419(R) (RRL-84)
radio-oxidation, 16: 25424(T) (AERE-Trans-894)
reactions with free methyl radicals, effects of structure and medium, 16: 25335
separation from deuterated isomers by partition chromatography, 16: 25427
HYDROCHLORIC ACID
separation from iron by solvent extraction using tertiary amines, effects of diluents on, 16: 25481 (PAN-303/V)
solvent properties for thorium dicarbide at room temperature, 16: 25365
solvent properties for praseodymium, 16: 25354
HYDRODYNAMICS
stability of viscous, between rotating cylinders, 16: 25537
HYDROFLUORIC ACID
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
HYDROGEN
corrosive effects on niobium and vanadium at operating conditions of Dounreay Fast Reactor, 16: 26475 (TID-7622(p.35-56))
crystal structure of para-, 16: 25977
determination in lunar atmosphere, 16: 26049
determination in niobium and its alloys, 16: 25294
determination in titanium alloys by hot extraction, 16: 25269 (NP-11834)
diffusion and solubility in beryllium, 16: 25757(R) (NMI-9815)
diffusion in uranium–zirconium alloys, theoretical kinetics and stresses of, 16: 25756 (NAA-SR-6264)
electron reactions, hydrogen ion production in, 16: 25955 (UCRL-6925)
exchange with deuterium, catalytic effects of doped germanium, 16: 25335
formation in swimming pool reactors by radiolysis of water, 16: 26498(T) (TID-7622(p.310-15))
meson (π^-) capture, Panofsky ratio for, 16: 26232 (UCRL-9884)
meson (π^-) capture, charge exchange in, 16: 26190
mesons (K) photoproduction in, 16: 25947 (NP-11977(p.137-9))
mesons (μ) transfer in mesic, 16: 26219 (JINR-P-942)
mesons (π^0) photoproduction in, 16: 25892 (LNF-62/37(p.46-56))
mesons (π^0) photoproduction in, 16: 25937 (NP-11977(p.107-8))
mesons (π^+) photoproduction in, 16: 25943 (NP-11977(p.124-6))
radiolysis yields in acetic acid and ethanol, 16: 25419(R) (RRL-84)
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
reactions with helium ions at 300 to 1500 kev, electron loss in, 16: 26021
reactions with helium, ionization cross sections, 16: 26238
reactions with oxygen in thorium oxide–uranium oxide slurries, use of molybdenum oxide catalyst in, 16: 25407(P)
separation from deuterium, process based on spectrometric resonance for, 16: 25688(T) (AEC-tr-5199)
sorption by niobium from potassium–sodium alloy at 350°C, 16: 25402
sorption effects on static fatigue of zirconium and its alloys, 16: 25746(R) (ARF-2230-9)
sorption effects on ductile-to-brittle transition in alloyed and unalloyed refractory metals, 16: 25751 (DMIC-Memo-155)
Stark effect in atomic, quantum mechanical interpretation of, 16: 25980
stopping power for recoil ions from alpha reactions (α,n), 16: 26243
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
yields from radiolysis of deaerated petroleum high-boiling fractions, effects of naphthalene on, 16: 25416 (PAN-289/ChR)
yields in radiolysis of labeled and unlabeled toluene, 16: 25412 (NAA-SR-6734)
HYDROGEN IONS
dissociation of molecular, 16: 26092(R) (TID-16031)
production of positive, upper limit in electron bombarded-hydrogen, 16: 25955 (UCRL-6925)
HYDROGEN ISOTOPES
exchange and replacement in organic compounds, book, 16: 25372(T)
exchange between tritiated water and proteins, 16: 25332
exchange in phosphorous acid solutions, 16: 25361
HYDROGEN PEROXIDES

formation in swimming pool reactors by radiolysis of water, 16: 26495(T) (TID-7622(p.310-15))
HYDROGENATION
catalysis, evaluation of beta radiation for, 16: 25414(R) (NYO-10184)
HYDROLOGY
electrical analog simulation of ground water flow, 16: 25613 (HW-73711)
HYDROMAGNETIC WAVES
mechanisms and stability in plasma, 16: 26407
HYPERFRAGMENTS
binding energies in Λ, at A = 3 to 13, 16: 26344
decay of $_{\Lambda}He^{4}$, meson (π^{+}) production in, 16: 26307
decay spectra of $_{\Lambda}He^{5}$, 16: 26363
production and decay of $_{\Lambda}Be^{7}$, 16: 26312
HYPERONS
electromagnetic form factors for, 16: 25896 (LNF-62/37(p.81-8))
interactions with nucleons, global symmetry and scattering, 16: 26091 (NYO-10234)
interactions with neutrinos, vector current structure for, 16: 26184
photoproduction of heavy, 16: 25945 (NP-11977(p.129-35))
production of Y_1^* in K^--N, π-Λ, and π-Σ interactions, 16: 26161
HYPERONS (Λ)
beta decay transition probabilities, 16: 26167
decay, self-consistent model for nonleptonic, 16: 26131 (UCRL-9863)
interactions with mesons (K) and nucleons, form factors for, 16: 26089 (NP-11832)
interactions with hyperons ($\bar{\Lambda}$) and nucleons (N) and ($\bar{N}$), dispersion relations, 16: 26110
interactions with mesons (π), resonant state at mass 1385 Mev, 16: 26134
interactions with mesons (π), properties of resonant, 16: 26158 (UCRL-10167)
interactions with mesons (π), resonances from, 16: 26161
interactions with nucleons, heavy-meson single exchange force in, 16: 26165
interactions with nucleons, spin dependence of, 16: 26344
interactions with mesons (π), S-wave J = ½ amplitudes, 16: 26111
production in mesons (π^{-})-proton interactions at 7 to 8 Bev, 16: 26068 (JINR-D-965)
HYPERONS (Λ^0)
angular distribution from mesons (π^{-}) reactions with Freon and xenon at 2.8 Bev, 16: 26189
photoproduction, measurement of cross sections for, 16: 25894 (LNF-62/37(p.72-5))
photoproduction, polarization in, 16: 25895 (LNF-62/37(p.76-80))
HYPERONS (Σ)
decay, self-consistent model for nonleptonic, 16: 26131 (UCRL-9863)
interactions with mesons (K) and nucleons, form factors for, 16: 26089 (NP-11832)
interactions with mesons (π), S-wave J = ½ amplitudes, 16: 26111
interactions with mesons (π), resonant states at masses 1405 and ~1530 Mev, 16: 26134
interactions with mesons (π), resonance at mass 1405 Mev, 16: 26137
interactions with mesons (π), properties of resonant, 16: 26158 (UCRL-10167)
interactions with mesons (π), resonances from, 16: 26161
lepton and proton decay, 16: 25920 (NP-11977(p.40-4))
HYPERONS (Σ^-)
beta decay transition probabilities, 16: 26167
beta emission, possible detection of, 16: 26141
decay asymmetry parameter for, 16: 26149 (UCRL-10238)
HYPERONS (Σ^0)
photoproduction, measurement of cross sections for, 16: 25894 (LNF-62/37(p.72-5))
HYPERONS (Σ^+)
decay mode, 16: 26143
HYPERONS (Ξ^-)
beta emission, possible detection of, 16: 26141

I

IMMUNITY
reactions in bone marrow transplantation, 16: 25109
reactions of transplanted tissues, effects of irradiation, 16: 25096(R) (TID-15980)
IMMUNIZATION
of mice by irradiated Sarcoma I ascites tumor, 16: 25108
IMPACT SHOCK
metal fracture under, 16: 25759 (NP-11890)
IN-PILE LOOPS
development, 16: 26603(T,R) (EURAEC-36)
INCOMPRESSIBLE FLOW
magnetohydrodynamic, about blunt bodies, 16: 25874 (AFOSR-2714)
magnetohydrodynamic, past nonconducting flat plate in transverse magnetic field, 16: 25913 (NP-11892)
INDIUM
magnetic and thermal properties, thermodynamic consistencies between, 16: 25805
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
INDIUM ISOTOPES In-111
production in cadmium-111 decay, mass discrepancies from, 16: 26287 (IS-408)
INDIUM ISOTOPES In-113
neutron capture cross sections at 10^3 to 10^4 ev, 16: 26518
INDIUM ISOTOPES In-114
energy levels and gamma spectra, 16: 26254
INDIUM ISOTOPES In-115
energy level strength functions for, 16: 26518
gamma reactions (γ,n) to 23 Mev, neutron yields from, 16: 26357
neutron capture cross sections at 10^3 to 10^4 ev, 16: 26518
INDIUM ISOTOPES In-116
energy levels and gamma spectra, 16: 26254
INDIUM--NIOBIUM ALLOYS
preparation of β-tungsten structure superconducting, 16: 25803
INDIUM--TIN ALLOYS
superconducting energy gap in, 16: 26010
INDIUM--URANIUM ALLOYS
thermodynamic properties at 450°C, 16: 25397
5-INDOLOL, 3-(2-AMINOETHYL)-
protective effects against whole-body radiation in mice, 16: 25252 (TID-16160)
radiosensitivity effects, effects of monamine oxidase inhibitors, 16: 25251(R) (TID-16159)
INDUCTION FURNACES
susceptor design and fabrication from refractory materials, 16: 25704
INDUCTION HEATING
nuclear power simulation in concentric fuel elements by, 16: 25605 (DC-55-11-47)
INDUSTRIAL MANAGEMENT
project scheduling in, PERT program for, 16: 25081 (CRIO-1091)
INFECTIONS
radioinduced resistance reduction in mice, protective effects of cysteine against, 16: 25258
INFLUENZA VIRUS
effects of ultraviolet radiation in *Hemophilus influenzae*, 16: 25152(R) (TID-16075)
mutations of *Hemophilus influenzae*, 16: 25152(R) (TID-16075)
INFRARED RADIATION
measurement, 16: 25595
INSECTS
radiation dosage determinations for two species of flour beetles, lethal, 16: 25146(R) (HW-72500(p.156-8))
radiation effects on bees, 16: 25203
radiation effects on development of Ephestia larvae, 16: 25134(R) (HW-72500(p.102-3))
INSTRUMENTATION
design requirements for space research, 16: 25588
developments in USSR of nuclear, for nuclear propulsion, 16: 25567 (NP-11947)
radioisotopes in, 16: 25683
INSTRUMENTS
design of magnet coupling for sodium flow controller, 16: 25569 (TID-15915)
INTERMEDIATE REACTORS

calculation methods for, 16: 26536
conference on physics of, 16: 26503 (STI/PUB/49(Vol.I))
conference on physics of, 16: 26535 (STI/PUB/49(Vol.II))
conference on physics of, 16: 26554 (STI/PUB/49(Vol.III))

INTERNATIONAL ATOMIC ENERGY AGENCY
safety regulations for containers for radioactive materials, 16: 25672
shipping regulations for highly radioactive materials, 16: 25671

INTESTINE
radiation effects on morphology and metabolite transport, 16: 25179 (TID-16270)
radiation effects on morphology and metabolite transport, 16: 25180 (TID-16271)
water absorption from, to blood and lymph, tracer study, 16: 25130(R) (HW-72500(p.84-7))

IODIDES
determination by stripping analysis using silver microelectrodes, 16: 25279

IODINE
determination by activation using iodine-129 as tracer, 16: 25264 (ANL-6577)
determination in meteorites, neutron activation, 16: 25623
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
neutron capture cross sections, 16: 26509
removal from gases, 16: 26636(R) (EURAEC-84)
uptake in thyroid gland of newborn lambs, tracer study, 16: 25118(R) (HW-72500(p.30-5))

IODINE ISOTOPES I-127
effectiveness as diluent of iodine-131 aerosol, 16: 25123(R) (HW-72500 (p.52-5))
energy level strength functions for, 16: 26518
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518

IODINE ISOTOPES I-128
reactions of recoil, 16: 25419(R) (RRL-84)

IODINE ISOTOPES I-129
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
tracer applications, 16: 25264 (ANL-6577)

IODINE ISOTOPES I-131
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
biological effects of chronic ingestion, in sheep and swine, 16: 25118(R) (HW-72500(p.30-5))
bonding with toluene, 16: 25417 (PAN-302/V)
deposition in bladder and stomach, gonad exposure from, 16: 25668
metabolism, effects of thyroid gland steady state function on, 16: 25105
separation from irradiated tellurium dioxide, 16: 25488
uptake by thyroid gland from aerosol, effects of iodine-127 dilution, 16: 25123(R) (HW-72500(p.52-5))

IODINE ISOTOPES I-132
bonding with toluene, 16: 25417 (PAN-302/V)

IODINE ISOTOPES I-133
energy levels, 16: 26239

ION BEAMS
reactions with gases at high energies, forces in, 16: 26041
reactions with gases above 0.2 kev, electron capture and loss in, 16: 26043

ION EXCHANGE MATERIALS
absorption properties of sodium aluminosilicate for strontium-90, 16: 25651 (HW-71574)
for separation of uranium from solutions, 16: 25497 (ACCO-66)
for separation of uranium from solutions, 16: 25465 (ACCO-26)
sorptive properties for fission products, 16: 26639(R) (HW-73412)

ION SOURCES
design and testing, 16: 26376(T) (FTD-TT-61-242)
development for heavy ion production, 16: 26230 (TID-16058)
extraction system design, for operation at radiofrequencies, 16: 25577(T) (NP-tr-902)
performance, mass spectroscopic evaluation, 16: 26390(T) (FTD-TT-61-242(p.162-6))

IONIZATION
book: *Ion Production by Electron Impact*, 16: 26022
production processes in noble gases between parallel-plate electrodes, 16: 26008

IONIZATION CHAMBERS
use in monitoring gas chromatography effluents, 16: 25428

IONOSPHERE
auroral ray detection in, with east-west speeds of 13 to 30 km/sec, 16: 26060
electron density in, measurement by r-f dispersion methods, 16: 26001

IONS
density in parabolic electric potential well, 16: 25885 (GEST-2002)
electron reactions, excitation and ionization cross sections for, 16: 26036
interactions between positive, thermodynamic effects of short-range, 16: 25875 (AFSWC-TDR-62-21)
motions in gases, 16: 26034
potential of systems of dipolar molecules and, classical theory, 16: 26019
reactions with atoms and molecules, excitation and ionization cross sections for, 16: 26036
reactions with atoms and molecules, charge transfer and electron detachment in, 16: 26042
recombination, 2- and 3-body, 16: 26032

IRIDIUM
fabrication of powders into crucible susceptors, 16: 25704
properties, theory of infrared and optical, 16: 25758 (NP-11675)

IRIDIUM ISOTOPES Ir-194
energy levels and gamma spectra, 16: 26254

IRON
corrosion, effects of surface saturation with aluminum or chromium, 16: 25721(T) (FTD-TT-61-31(p.60-9))
deformation, stored energy increase and release after, 16: 25821
density of liquid at 1800 to 2500°K, 16: 25825
determination in lead foil, activation, 16: 25281
determination in niobium and its alloys, 16: 25294
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
gamma resonance absorption in Armco, 16: 26225 (NP-11913)
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
meson (μ^-) capture, detection of, 16: 26142
neutron capture cross sections, 16: 26509
neutron scattering, fast, 16: 26505 (TID-13546)
separation from beryllium by solvent extraction using phosphate esters, 16: 25475 (NCL/AE-172)
separation from hafnium and zirconium by ion exchange, 16: 25278(T) (SCL-T-423)
separation from hydrochloric acid by solvent extraction using tertiary amines, effects of diluents on, 16: 25481 (PAN-303/V)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
thermal cycling, 16: 25085 (JAERI-7022)
wetting by liquid sodium, effects of additions of barium and calcium to sodium and of oxide films, 16: 25782

IRON ALLOYS
corrosion by high-temperature steam, 16: 26467(R) (HW-73100)
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)

IRON CARBONATES
antiferromagnetic behavior, 16: 25882 (ASD-TR-61-630)
thermal dissociation at 1 atmosphere pressure, 16: 25319 (TID-16128)

IRON(III) IONS
equilibrium effects on anionic XX resin and uranyl sulfates, 16: 25330

IRON ISOTOPES Fe-56
gamma resonance absorption, 16: 26225 (NP-11913)
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
proton reactions (p,n) at 17 Mev, effects of excited isobaric states, 16: 26333 (UCRL-6830)

IRON ISOTOPES Fe-57
hyperfine splitting of, in transition metals, 16: 25999
Mössbauer effect in, line broadening and transmission in, 16: 26225 (NP-11913)

IRON–NIOBIUM ALLOYS
phase studies of precipitation of Laves phases from, 16: 25827

IRON OXIDE–VANADIUM OXIDE SYSTEMS

magnetic properties and structure, 16: 25366
IRON OXIDES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
IRON–PLUTONIUM ALLOYS
corrosive effects on tantalum container, effects of carbon on, 16: 26577(P)
heats of formation, 16: 25834
IRON SULFIDE CRYSTALS
neutron double Bragg scattering by single, angular distributions, 16: 26211
IRON–TITANIUM ALLOYS
phase studies of precipitation of Laves phases from, 16: 25827
phase transformations, 16: 25830
IRON–URANIUM ALLOYS
heats of formation, 16: 25834
IRON–WATER SYSTEMS
neutron attenuation, 16: 26192 (AEEW-R-125)
IRON–ZIRCONIUM ALLOYS
phase transformations, 16: 25829
IRRADIATION FACILITIES
design of electron, for studies of organic dielectrics, 16: 25855
ISOTOPE EFFECTS
analysis of secondary in molecular structure, 16: 25348 (IS-454)
measurement of, method for continuous, 16: 25410 (CEA-2120)
on intermolecular interactions and vapor pressures, 16: 25304 (BNL-6050)
ISOTOPE SEPARATION METHODS
development for light molecules based on spectrometric resonance, 16: 25688(T) (AEC-tr-5199)
effusion through nozzle, theory, 16: 25687(T) (AEC-tr-5069)
ISOTOPES
uses in catalysis, conference, 16: 25261(T) (JPRS-13785)
ISOTOPIC EXCHANGE
book: *Isotopic Exchange and the Replacement of Hydrogen in Organic Compounds*, 16: 25372(T)
ISRAEL
water sources, radium and radon concentrations in, 16: 25624
ITALY
uranium mineralization in Alps, 16: 25634 (CNEN-53)
ITALY (LOMBARDY)
ecology, 16: 25166 (CNI-54)

J

JANGLE OPERATION
blast effects on constructed family defense shelters, 16: 25657 (WT-359)
JAPAN
gamma dose rates from natural sources in, 16: 25675

K

KEROSENE
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
KETONES
preparation of cyclic derivatives from aliphatic secondary or tertiary thiol- primary amino-hydrochlorides, 16: 25249(R) (NP-11740)
KIDNEYS
bismuth sulfide retention in rabbit, intravenously injected colloidal, 16: 25104
KRYPTON
reactions with helium ions at 300 to 1500 kev, electron loss in, 16: 26021
reactions with helium, ionization cross sections, 16: 26238
release from irradiated thorium carbide-uranium carbide systems in graphite matrix at 900 to 2000°C, 16: 25752 (GA-3211)
separation from flowing helium stream by fixed-bed adsorption, 16: 26489 (TID-7622(p.218-35))
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
KRYPTON ISOTOPES Kr-89
determination in fission gases, spectrometric, 16: 25295
KRYPTON ISOTOPES Kr-91
determination in fission gases, spectrometric, 16: 25295
KRYPTON ISOTOPES Kr-92
determination in fission gases, spectrometric, 16: 25295

L

LABORATORIES
design and construction, bibliography, 16: 25500 (KFK-69)
design and construction of clean room, 16: 25509 (TID-16274)
ventilating systems for radioisotope, 16: 25676
LABORATORY EQUIPMENT
design of automatic blood cell scanner, 16: 25568 (NYO-9644)
LACTIC ACID COMPLEXES
with sulfur, protective effects against radiation injuries in mice, 16: 25253
LACTONES
protective effects against radiation injuries in mice, 16: 25253
LANTHANUM
determination in silicate rocks, combined cation exchange-spectrochemical, 16: 25287
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
solvent properties for plutonium, 16: 25474 (IS-470)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
LANTHANUM ISOTOPES La-140
beta decay, photon circular polarization from, 16: 26292
determination in fission gases, spectrometric, 16: 25295
LANTHANUM ISOTOPES La-141
determination in fission gases, spectrometric, 16: 25295
LANTHANUM MANGANATES
magnetic exchange and structure in, 16: 25882 (ASD-TR-61-630)
LANTHANUM OXIDES
thermodynamic properties, 16: 25386
LEAD
deformation, stored energy increase and release after, 16: 25821
determination, micro-coulometric, 16: 25285
energy levels, isotopic shifts in, 16: 26360
fracture under impulsive loading, 16: 25759 (NP-11890)
meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
neutron capture cross sections, 16: 26509
neutron scattering at 0.0026 to 10.4 kev, spectra from, 16: 25586
properties, theory of infrared and optical, 16: 25758 (NP-11675)
proton fission at 660 Mev, charge spectra from, 16: 26329
proton reactions at 120 to 660 Mev, astatine isotope production in, 16: 26220 (JINR-P-950)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
thermal desorption energy on glass and mica, 16: 26009
LEAD FOILS
analysis for iron and uranium, activation, 16: 25281
LEAD ISOTOPES
content in minerals, age estimation by, 16: 25626
LEAD ISOTOPES Pb-206
photofission cross sections up to 18.5 Mev, 16: 26261
LEAD ISOTOPES Pb-207
photofission cross sections up to 18.5 Mev, 16: 26261
LEAD ISOTOPES Pb-208
gamma emission, analysis of collective E3 and E4, 16: 26271
photofission cross sections up to 18.5 Mev, 16: 26261
proton scattering at 30.8 Mev, angular distributions, 16: 26282
LEAD ISOTOPES Pb-209
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
LEAD ISOTOPES Pb-212
beta decay, 16: 26009
LEAD ISOTOPES Pb-214
beta decay, 16: 26009
LEAD OXIDES
beta recoil of bismuth-212 and -214 from, 16: 26009
LEAD–URANIUM ALLOYS
thermodynamic properties at 450°C, 16: 25397

LECTURES
book: *The Theory of Fundamental Processes*, 16: 26453
LEECHES
radiosensitivity, effects of ploidy, 16: 25198 (CNEN-117)
LEPTONS
energy spectra from meson (K_{μ_3}) decay, 16: 26160
interactions in universal Fermi theory, avoidance of unwanted, 16: 26109
interactions, strangeness considerations in weak, 16: 26099
production in beta annihilation, 16: 26185
LEUKEMIA
etiology, inherited and somatic mutations in, 16: 25106
radioinduced in mice, 16: 25199
LEUKOPENIA
radioinduced in rabbits, protective effects of orotic acid on, 16: 25257
LIFE SPANS
effects of embryonic irradiation in mice, 16: 25177(R) (TID-16129)
LIGHT
measurement, 16: 25595
LINEAR ACCELERATORS
design and testing, 16: 26376(T) (FTD-TT-61-242)
electron focusing by periodic magnetic fields in, 16: 26380(T) (FTD-TT-61-242(p.33-6))
electron trajectories in, 16: 26379(T) (FTD-TT-61-242(p.22-32))
electron, with magnetic field traveling velocity exceeding speed of light, 16: 26394
focusing of electron beams in, 16: 26381(T) (FTD-TT-61-242(p.37-42))
power distribution in basic accelerating harmonic, 16: 26383(T) (FTD-TT-61-242(p.46-53))
radial oscillations of electrons in, graphic calculations, 16: 26382(T) (FTD-TT-61-242(p.43-5))
radial particle oscillations in electron, 16: 26378(T) (FTD-TT-61-242 (p.3-21))
waveguide phase velocity measurement, comparison of phasometer circuits for, 16: 26387(T) (FTD-TT-61-242(p.134-46))
waveguide phase velocity, measurement by traveling-wave technique, 16: 26388(T) (FTD-TT-61-242(p.151-61))
LIPIDS
radiation effects on liver mitochondrial levels, whole-body exposure, 16: 25178(R) (TID-16131)
radiation effects on unsaturation variations in serum, in rabbits, 16: 25229
LIQUID BATHS
design of high-temperature thermostatic, use of fluidization techniques, 16: 25513(T) (NP-tr-888)
LIQUID METAL COOLED REACTORS
development at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
LIQUIDS
heat transfer in boiling, electroconvection effects on, 16: 25533
representations of systems of dipoles and ions, classical theory, 16: 26019
LITHIUM
content in granites, age estimation from, 16: 25630
corrosive effects on containment alloys and metals at high temperatures, review, 16: 25714 (DMIC-169)
corrosive effects on cobalt, iron, nickel, and refractory base alloys, 16: 25718 (NP-11952)
ion-core states in, effects of crystal field on, 16: 25884 (DI-82-0171)
oxidation at 78 to 300°K, 16: 25727
LITHIUM CHLORIDE–POTASSIUM CHLORIDE SYSTEMS
chemical properties of sulfur, uranium, and vanadium in eutectic of, 16: 25306 (CEA-2125)
LITHIUM CHLORIDES
complex formation in aqueous solutions with thorium(IV) chlorides, methods of detection, 16: 25358
LITHIUM COMPOUNDS
preparation of oxonide, use of ammonia in, 16: 25338
LITHIUM FLUORIDE CRYSTALS
ionic conductivity in plastically deformed, measurements of excess, 16: 25316 (NP-11921)
neutron double Bragg scattering by single, angular distributions, 16: 26211
LITHIUM HYDRIDES
corrosive effects on cobalt, iron, nickel, and refractory base alloys, 16: 25718 (NP-11952)
crystal structure and electron distribution, neutron and x-ray diffraction analysis of, 16: 25800
LITHIUM ION BEAMS
reactions (Li^6,α) on carbon-12, angular distributions from, 16: 26249
LITHIUM IONS
electron correlation and Hartree-Fock energies of 1s2s ^1S and ^3S states, 16: 26004
LITHIUM ISOTOPES Li-6
alpha and deuteron reactions, resonant particle-transfer processes in, 16: 26299
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
energy spectrum in intermediate-coupling shell model, 16: 26276
reactions (lithium-6,α) with carbon-12, differential cross sections for, 16: 26321
reactions with lithium-6 and 7 at 2.5 to 2.75 Mev, gamma spectra from, 16: 26325
separation from lithium-7 by ion exchange, 16: 25689 (IS-278)
LITHIUM ISOTOPES Li-7
energy levels with $J = 5/2$, nuclear-models for, 16: 26247
gamma reactions (γ,p) at 12 to 16 Mev, proton spectra from, 16: 26353
proton quasi-elastic scattering cross sections, 16: 26273
proton reactions (p,α) up to 4.8 Mev, angular distributions, 16: 26262
reactions (lithium-7,α) with carbon-12, differential cross sections for, 16: 26321
reactions with lithium-6 and 7 at 2.5 to 2.75 Mev, gamma spectra from, 16: 26325
separation from lithium-6 by ion exchange, 16: 25689 (IS-278)
LITHIUM–LITHIUM HYDRIDE SYSTEMS
corrosive effects on cobalt, iron, nickel, and refractory base alloys, 16: 25718 (NP-11952)
LITHIUM SULFATES
proton conductivity in monohydrate and water molecule motion, 16: 25333
LIVER
bismuth sulfide retention in rabbit, intravenously injected colloidal, 16: 25104
phosphorus-32 excretion in bile of, in rabbits, 16: 25156
radiation effects on regenerating, 16: 25132(R) (HW-72500(p.92-6))
radiation effects on lipid metabolism, 16: 25178(R) (TID-16131)
radiation effects on DNA and RNA in, gamma and x, 16: 25208
scintillation scanning for radioactive materials, 16: 25098
scintillation scanning for deposited radioactive materials, 16: 25099
scintillation scanning after administration of iodine-131 rose bengal or colloidal gold-198, 16: 25190
size estimation by scintillation scanning technique, 16: 25100
succinic dehydrogenase activity in cancerous and normal mouse, effects of fatty acid extract from irradiated rabbits on, 16: 25224
thorium dioxide uptake in rabbit, colloidal, 16: 25162
LIVER DISEASES
diagnosis, comparison of iodine-131 rose bengal and colloidal gold-198 in scintillation scanning, 16: 25190
diagnosis, with aid of contrast radiography and radioisotope scanning, 16: 25101
LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENTS
critical-mass and reflectivity measurements at 80 to 480°C, 16: 26523
LOS ALAMOS TURRET REACTOR
development, 16: 26596(R) (LAMS-2722)
LUNGS
radiation effects on, from breast cancer therapy, 16: 25160
radioinduced chromosome aberrations in human fetal, 16: 25181(R) (TID-16317)
LUTETIUM
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
LUTETIUM OXIDES
thermodynamic properties, 16: 25386
LYMPH
water absorbed by, from intestine, tracer study, 16: 25130(R) (HW-72500 (p.84-7))

LYMPH SYSTEM
phosphorus-32 injection effects on blood cells in rabbit, 16: 25202
LYSOLECITHIN
radioinduced, morphological effects on hematopoietic system, 16: 25226

M

MACHINING
development, state-of-the-art in aerospace areas, 16: 25501 (MAB-139-M(M5))
MAGNESIUM
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
neutron capture cross sections, 16: 26509
oxidation at low pressures at 77 to 304°K, 16: 25716 (NP-11876)
radioinduced heating, design of calorimeter for measuring gamma and neutron, 16: 26502
MAGNESIUM ALLOYS
creep cavities, methods for metallographic examination of intergranular, 16: 25790
MAGNESIUM CERIUM NITRATES
nuclear alignment of cerium-141 in, 16: 26224 (NP-11865)
MAGNESIUM CHLORIDES
free energy of formation at 400 to 600°C, 16: 25392
MAGNESIUM ISOTOPES Mg-24
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
giant E1 resonance in, analysis by random-phase approximation, 16: 26253
MAGNESIUM ISOTOPES Mg-25
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
energy levels, 16: 26306
MAGNESIUM ISOTOPES Mg-26
energy levels, 16: 26306
energy levels from deuteron reactions (d, helium-3) with aluminum-27 at 12.8 Mev, 16: 26313
proton reactions (p,α) at 9.90 Mev, sodium-23 energy levels from, 16: 26310
MAGNESIUM ISOTOPES Mg-28
exchange with chlorophyll a, 16: 25155
MAGNESIUM OXIDE COATINGS
preparation and properties, 16: 26476 (TID-7622(p.57-73))
MAGNESIUM OXIDES
radiation effects on defect clusters in, 16: 25865
reactions with sodium vapor at 940°C, 16: 25318 (RAD-TM-60-44)
reactions with uranium oxides at high pressure and 900 to 1200°C, 16: 25302 (BMI-1585)
MAGNESIUM–SILICON CRYSTALS
electric conductivity, Hall coefficients and mobility, and Seebeck coefficients at 7 to 1000°K of p- and n-type Mg_2Si single, 16: 25799 (IS-362)
MAGNESIUM–THORIUM ALLOYS
electric conductivity of liquid and solid, 16: 25754 (IS-437)
MAGNETIC FIELDS
analysis of spiral, 16: 26371 (JINR-P-930)
conduction maximum variation principle for, 16: 25988
design for use in swimming pool reactor irradiations, 16: 26615 (CEA-2134)
flow past nonconducting flat plate in transverse, 16: 25913 (NP-11892)
force line distribution in, 16: 26402 (JINR-P-929)
motion of plasma across, 16: 26414 (UCRL-6294)
MAGNETIC RESONANCE
relaxation, temperature effects on spin-lattice, 16: 25995
MAGNETISM
measurements in ferromagnetic materials, pulsed-field, 16: 25882 (ASD-TR-61-630)
MAGNETITES
nuclear spin-wave properties in, 16: 25979
MAGNETOHYDRODYNAMIC CELLS
properties and prospective electric-power uses, review, 16: 25089
MAGNETOHYDRODYNAMICS
adiabatic invariants in, asymptotic behavior of, 16: 26422
cosmic, 16: 26051
electric conductivity of cold plasma at high current densities, 16: 26412
electromagnetic radiation from plane turbid layers, 16: 26425
flow about blunt bodies, 16: 25874 (AFOSR-2714)
flow past nonconducting flat plate in transverse magnetic field, 16: 25913 (NP-11892)
irreversible processes in, theory of, 16: 26415
plasma equations, 16: 26420
plasma interactions with electron beams in, 16: 26424
MAGNETS
current regulator, design of transistorized, 16: 25566 (NP-11883)
design and performance of air-core electro-, for plasma research, 16: 26403 (PAN-301/XVIII)
design of analyzing, for particle interaction products, 16: 25910(R) (NP-11749)
performance of iron-core, in pulsed operation, 16: 25969
pole face windings, 16: 26370 (DESY-A1.9)
properties and uses of superconducting, survey, 16: 25881 (ASD-TN-61-160)
MAN
cesium metabolism, 16: 25157
chromosome aberrations in, relation between pathological conditions and, 16: 25181(R) (TID-16317)
fission product permissible limits, 16: 25643 (CEA-2163)
plutonium distribution from fallout, 16: 25171
radiation effects combined with hematoporphyrin on glycolysis in cancer tissue on, 16: 25234
radiotherapy of non-malignant diseases of neck and pharynx, cancer induction in, 16: 25201
treatment of radiation injuries from high dose level exposures, 16: 25184(T) (SCL-T-424)
MANGANATES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
MANGANESE
coprecipitation with calcite at 90 to 325°C, 16: 25319 (TID-16128)
determination in aluminum, activation, 16: 25288
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
fluorescence, K-shell yields, 16: 26000
MANGANESE CHROMIUM FERRATES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
MANGANESE FERRATES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
MANGANESE FLUORIDES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
spin-flopping in MnF_2, induced by high pulsed magnetic fields, 16: 25882 (ASD-TR-61-630)
MANGANESE ISOTOPES Mn-51
energy levels in, resonance, 16: 26235
MANGANESE ISOTOPES Mn-53
energy levels in, resonance, 16: 26235
MANGANESE ISOTOPES Mn-54
electron capture decay, K-shell fractions, 16: 26336
energy levels in, resonance, 16: 26235
MANGANESE ISOTOPES Mn-55
energy levels in, resonance, 16: 26235
MANGANESE OXIDES
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
MANNOSE
radiolysis of solution *in vacuo*, tracer and paper-chromatographic studies of products from, 16: 25439
MARCOULE REACTORS
operation and testing, 16: 26460 (CEA-2158)
MARITIME GAS COOLED REACTOR
design objectives for land-based, 16: 26592 (GA3D-1722)
MARITIME PRESSURIZED WATER REACTOR
materials, 16: 25760 (ORNL-3281)
MARITIME REACTORS
coolant pumps, comparison of electric and steam drives, 16: 26584 (CEND-150(Pt.IV))
MARTENSITES
phase transformations in, dilation parameters in, 16: 25763 (TID-16191)
MASS SPECTROGRAPHY
appearance potential determination by critical slope method, 16: 25320

(TID-16157)
MASS SPECTROMETERS
design for evaluating ion sources, 16: 26390(T) (FTD-TT-61-242 (p.162-6))
design for gaseous uranium hexafluoride samples, 16: 25600(P)
design for increased resolution using electrostatic mirrors, 16: 25576(T,P) (FTD-TT-62-369)
design of wide angle, for analyses of molybdenum-uranium hexafluoride mixtures, 16: 25313 (K-1433)
MASS TRANSFER
conference, Minsk, USSR, Jun. 1961, 16: 25527 (RM-2852-PR)
through fixed and fluidized beds, 16: 25532
MATERIALS TESTING
equipment for fatigue testing, 16: 25606 (TID-15356)
MATERIALS TESTING REACTOR MOCKUP
fuel cycles and loading programming for, 16: 26620 (ORNL-TM-277)
MATHEMATICS
block iterative methods for two-cycle matrix equations, 16: 25691 (WAPD-TM-327)
divergences in unrenormalized theories, 16: 26079 (JINR-P-964)
regularization of equations of Chu-Low type for meson (π)–nucleon interactions, 16: 26072 (JINR-P-891)
research programs at Hahn-Meitner Institute for Nuclear Research, 1961, 16: 25083 (HMI-B-22)
role of Newton's polygon in present development of, 16: 25692(T) (AEC-tr-5139)
MATTER
kinetic and scattering properties, relations between, 16: 26440
MECHANICS
statistical, approximations of pair distribution functions in fluids, 16: 26445
MEMBRANE FILTERS
properties of molecular, for purifying carbon dioxide, 16: 25299 (AAEC/E-86)
MERCURY
determination in presence of ethylenediamine, method for, 16: 25272(R) (TID-16332)
effects of inhaled vapor on behavior of pigeons, 16: 25154 (UR-578)
electric arcs in, movement of ball-of-fire and cathode spot during, 16: 26018
energy levels, isotopic shifts in, 16: 26360
heat of absorption on silver, 16: 26009
neutron capture cross sections, 16: 26509
properties, theory of infrared and optical, 16: 25758 (NP-11675)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
MERCURY ISOTOPES
nuclear properties, rms charge radii and emission-spectra isotope shifts, 16: 26331
MERCURY ISOTOPES Hg-195
nuclear spin of ground-state and excited, 16: 26331
MERCURY ISOTOPES Hg-203
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
MESIC ATOMS
meson (μ^-) decay in, of palladium, titanium, and their hydrides, 16: 26080 (JINR-P-972)
mesons (μ) transfer in, 16: 26219 (JINR-P-942)
MESON BEAMS
production of polarized pseudovector and vector, 16: 26124
MESON SPECTRA
analogy to Cherenkov radiation, 16: 26096
MESONS
decay of vector, from electron pair annihilation processes, 16: 26185
electromagnetic form factors for, 16: 25896 (LNF-62/37(p.81-8))
interactions with nucleons at high energies, spin amplitudes in, 16: 26191
photoproduction of neutral, with mass between 300 and 800 Mev, 16: 25898 (LNF-62/37(p.98-104))
photoproduction of heavy, 16: 25945 (NP-11977(p.129-35))
production, fire-ball model for multiple, 16: 26170
MESONS (η)
decay, relation to meson ($K^{\pm}_{\pi 3}$) decay, 16: 26150
decay scheme, 16: 26138
photoproduction in ($\gamma + p$) reactions, 16: 25897 (LNF-62/37(p.89-98))
production and properties from π^+-d interactions, 16: 26165
properties review, 16: 26158 (UCRL-10167)
MESONS (K)
decay of K-π resonance (K^*), effects of spin-parity assignments on, 16: 26157
interaction amplitudes, 16: 26083 (JINR-P-1000)
interactions with nucleons, cross sections, 16: 25877(R) (ANL-6534)
interactions with protons at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions with hyperons and nucleons, form factors for, 16: 26089 (NP-11832)
interactions with mesons (π), effects on K_{e3} and $K_{\mu 3}$ decays, 16: 26103
interactions with mesons (π), resonant states at masses 730 and 885 Mev, 16: 26134
interactions with nucleons, S-wave meson ($\bar{K}$)-nucleon scattering amplitudes, 16: 26137
interactions with mesons (π), properties of resonant, 16: 26158 (UCRL-10167)
interactions with nucleons, polarization in, 16: 26191
photoproduction in hydrogen, 16: 25947 (NP-11977(p.137-9))
production in electron-positron interactions, 16: 25906 (LNF-62/37 (p.166-79))
production in meson (π^-)-proton interactions at 1.89 and 2.10 Bev/c, cross sections for, 16: 26146
MESONS (K^-)
capture in nuclear emulsions, effects of nuclear mass, 16: 26084 (NP-11623)
interactions with protons, hyperon (Σ^+) production in, 16: 26143
interactions with nucleons, resonances from, 16: 26161
reactions with nuclei in emulsions, $_{\Lambda}Be^9$ production in, 16: 26312
MESONS (K^0)
angular distribution from mesons (π^-) reactions with Freon and xenon at 2.8 Bev, 16: 26189
decay, nonvalidity of $\Delta I = \frac{1}{2}$ and $\Delta S = +\Delta Q$ rules in 3-body, 16: 26151
interactions with mesons (K^0), orbital angular momentum in, 16: 26078 (JINR-P-960)
magnetic moments, upper limit for, 16: 26182
production in mesons (π^-)-proton interactions at 7 to 8 Bev, 16: 26068 (JINR-D-965)
MESONS (K^+)
decay, 16: 25920 (NP-11977(p.40-4))
decay products, 16: 25945 (NP-11977(p.129-35))
photoproduction, experimental and theoretical status, 16: 25946 (NP-11977(p.135-7))
photoproduction, measurement of cross sections for, 16: 25894 (LNF-62/37(p.73-5))
polarization, hyperon (Λ^0) polarization in, 16: 25895 (LNF-62/37 (p.76-80))
MESONS (K_{e3})
decay, effects of meson (K)-meson (π) resonances, 16: 26103
MESONS ($K^{\pm}_{e3}$)
decay, form factors, 16: 26135
decay, lepton energy spectra from, 16: 26160
MESONS (K_{e4})
decay spectra and $KK \rightarrow \pi\pi$ amplitudes, 16: 26083 (JINR-P-1000)
MESONS ($K_{\mu 3}$)
decay, effects of meson (K)-meson (π) resonances, 16: 26103
MESONS ($K^{\pm}_{\mu 3}$)
decay, form factors, 16: 26135
decay, lepton energy spectra from, 16: 26160
MESONS ($K^{\pm}_{\pi 2}$)
decay, meson (π) resonance production in S-wave, I = 2 isospin state, 16: 26117
MESONS ($K^{\pm}_{\pi 2}$)
decay, meson (π) resonance production in S-wave, I = 2 isospin state, 16: 26117
MESONS ($K^{\pm}_{\pi 3}$)
decay, relation to meson (η) decay, 16: 26150
MESONS (μ)
capture, measurement of radiative, 16: 25923 (NP-11977(p.53-4))
magnetic moment, anomalous, 16: 26115

magnetic moment of, anomalous, 16: 26095
photoproduction of pairs in carbon, 16: 25899 (LNF-62/37(p.105-9))
photoproduction on nuclei, experimental set-up measuring, 16: 25931 (NP-11977(p.90-2))
transfer in mesic atoms, 16: 26219 (JINR-P-942)
MESONS (μ^-)
capture by nuclei, photon angular distributions from, 16: 26236
capture in iron, detection of, 16: 26142
capture, measurement of neutron polarization by, 16: 25922 (NP-11977(p.49-52))
decay, electron polarization in, 16: 26177
decay in mesic atoms of palladium, titanium, and their hydrides, 16: 26080 (JINR-P-972)
MESONS (μ^+)
decay, electron polarization in, 16: 26177
MESONS (ω)
decay, effects of spin-parity assignments on, 16: 26157
interactions with nucleons, coupling constant for, 16: 26175
production and properties from π^+-d interactions, 16: 26165
production in antiproton-proton interactions, ω-N coupling constant from, 16: 26175
properties review, 16: 26158 (UCRL-10167)
MESONS (π)
decay of charged, spectra of radiative, 16: 26113
decay of K-π resonance (K^*), effects of spin-parity assignments on, 16: 26157
distributions from $_{\Lambda}He^5$ decay, 16: 26363
exchange in particle interactions, non-static effects in single, 16: 26166
form factors for, linear equations for determining, 16: 26085 (NP-11632)
interactions, amplitudes for, 16: 26169
interactions in S-wave, I = 2 isospin state, resonance in, 16: 26117
interactions, perturbation 2-π approximation for, 16: 26129
interactions, resonance properties of, 16: 26118
interactions with protons at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions with nucleons, regularization of equations for, 16: 26072 (JINR-P-891)
interactions with nucleons, 16: 26076 (JINR-P-938)
interactions with mesons (π), resonances in, 16: 26076 (JINR-P-938)
interactions with mesons (π) and nucleons, dispersion relations for, 16: 26077 (JINR-P-949)
interactions with nucleons, form factors for, 16: 26089 (NP-11832)
interactions with mesons (K), effects on K_{e3} and $K_{\mu 3}$ decays, 16: 26103
interactions with protons at 290 to 1500 Mev, 16: 26104
interactions with nucleons, coupling constant for, 16: 26105
interactions with hyperons (Λ) and (Σ), S-wave J = $^1/_2$ amplitudes, 16: 26111
interactions with protons at 2.1 Bev/c, kinematics, 16: 26134
interactions with hyperons (Λ) and (Σ) and mesons (K), resonances, 16: 26134
interactions with hyperons (Σ), resonance at 1405 Mev, 16: 26137
interactions with nucleons, vertex function in, 16: 26144
interactions with nucleons, complex angular momentum plane singularities in, 16: 26153
interactions with hyperons and mesons, properties of resonant, 16: 26158 (UCRL-10167)
interactions with protons, high-energy, 16: 26159
interactions with hyperons (Λ) and (Σ), resonances from, 16: 26161
interactions with nucleons, amplitude relation to π-π amplitudes, 16: 26169
interactions with bosons, meson multiple production in, 16: 26170
interactions with nucleons, meson (π) production in, 16: 26174
interactions with nucleons, polarization in, 16: 26191
interactions with nucleons in heavy nuclei, 16: 26340
lifetime, measurement of mean, 16: 25901 (LNF-62/37(p.118-38))
pair production in emulsions, 16: 25927 (NP-11977(p.66-7))
photoproduction at high energies, parity conservation in, 16: 25889 (LNF-62/37(p.13-23))
photoproduction in helium, anisotropy in distribution from, 16: 25888 (LNF-62/37(p.10-13))
photoproduction in deuterium and hydrogen, 16: 25943 (NP-11977 (p.124-6))
photoproduction in deuterium, hydrogen, and heavy nuclei, 16: 25945 (NP-11977(p.129-35))
photoproduction on nucleons, amplitude integral equations for, 16: 26094
photoproduction, parity conservation in, 16: 25944 (NP-11977(p.127-9))
photoproduction, peripheral model interpretation of double, 16: 25887 (LNF-62/37(p.7-9))
photoproduction, peripheral interaction in, 16: 25942 (NP-11977 (p.121-3))
production and decay of heavy, 16: 26144
production in hyperon (Λ) and (Σ) decay, self-consistent model for, 16: 26131 (UCRL-9863)
production in meson (π)-proton interactions at 290 to 1500 Mev, 16: 26104
production in neutrino-nucleon interactions, 16: 26074 (JINR-P-905)
production in proton reactions with nuclei, 16: 26089 (NP-11832)
production in proton reactions on helium-3 and tritium, cross sections, 16: 26260
production resonances of antiproton-proton interactions at 1.67 Bev, 16: 26233 (UCRL-10129)
reactions in emulsions at 14 Bev/c, 16: 25927 (NP-11977(p.66-7))
reactions with nuclei, nucleon pair production in, 16: 26089 (NP-11832)
scattering by mesons (π), asymptotic behavior, 16: 26069 (JINR-E-943)
MESONS (π^-)
capture by complex nuclei, neutron spectrum from, 16: 25902 (LNF-62/37(p.138-42))
capture in deuterium and hydrogen, branching and Panofsky ratios for, 16: 26232 (UCRL-9884)
decay, neutrino production and properties from, 16: 26147
interactions with protons at 170 Mev, direct measurement of cross sections for charge-exchange, 16: 25924 (NP-11977(p.55-7))
interactions with protons at 7 to 8 Bev, 16: 26068 (JINR-D-965)
interactions with nucleons at 7 Bev, properties of mesons (π^0) formed in inelastic, 16: 26081 (JINR-P-974)
interactions with protons at 310 Mev, phase shifts and scattering cross sections for, 16: 26093 (UCRL-10252)
interactions with protons, effects of meson (ρ) resonances, 16: 26114
interactions with protons at 16 Bev, cross-section relation to Pomeranchuk-trajectory slope, 16: 26122
interactions with protons to 1.9 Bev, dispersion relations for, 16: 26123
interactions with protons at 20.7 and 31.0 Mev, charge-exchange cross sections for, 16: 26127 (NYO-9545)
interactions with protons at 1.89 and 2.10 Bev/c, meson (K) production cross sections for, 16: 26146
interactions with protons below 1 Bev, meson (ζ) even isotopic spin from, 16: 26152
interactions with protons at 7.2 Bev, differential cross sections for elastic, 16: 26180
reaction with hydrogen and polyethylene, charge, exchange ratio in, 16: 26189
reactions with carbon, chloride, fluoride, and xenon at 2.8 Bev, 16: 26190
scattering on carbon at 5 to 15 Mev, angular distribution in elastic, 16: 26365
MESONS (π^0)
photoproduction by polarized gamma, 16: 25933 (NP-11977(p.94-6))
photoproduction, differential cross sections for second resonance, 16: 25891 (LNF-62/37(p.34-9))
photoproduction, differential cross sections for, 16: 25890 (LNF-62/37(p.28-34))
photoproduction dispersion relations, contribution from unobserved region, 16: 26073 (JINR-P-904)
photoproduction, energy levels and resonances in, 16: 25939 (NP-11977(p.111-15))
photoproduction in hydrogen, cross sections and experimental apparatus for, 16: 25892 (LNF-62/37(p.46-56))
photoproduction in hydrogen, 16: 25936 (NP-11977(p.102-4))
photoproduction in hydrogen, 16: 25937 (NP-11977(p.107-8))
photoproduction in Coulomb field, measurement of Primakoff effect in, 16: 25938 (NP-11977(p.109-10))
photoproduction on nuclei, Primakoff effect in, 16: 25893 (LNF-62/37 (p.57-71))
photoproduction, polarized gamma, 16: 25934 (NP-11977(p.97-99))

photoproduction, recoil proton polarization in, 16: 25941 (NP-11977 (p.120-1))
production in inelastic meson (π^-)-nucleon interactions at 7 Bev, 16: 26081 (JINR-P-974)
production in mesons (π^-) capture in hydrogen and polyethylene, 16: 26190
production in nucleon interactions, angular distributions from, 16: 26082 (JINR-P-981)
MESONS (π^+)
decay, neutrino production and properties from, 16: 26147
interactions with protons at 820, 900, and 1050 Mev, angular distributions and cross sections for, 16: 26120
interactions with protons below 1 Bev, meson (ζ) even isotopic spin from, 16: 26152
interactions with deuterons, mesons (η) and (ω) production and properties from, 16: 26165
interactions with protons at 310 Mev, phase shifts and scattering cross sections for, 16: 26093 (UCRL-10252)
photoproduction with polarized photons, 16: 25935 (NP-11977(p.99-100))
production in Δfie^4 decay, 16: 26307
MESONS (ρ)
decay, effects of spin-parity assignments on, 16: 26157
interactions with mesons (π^-) and protons, resonant, 16: 26114
properties review, 16: 26158 (UCRL-10167)
MESONS (ζ)
production in meson (π) interactions with protons below 1 Bev, 16: 26152
METABOLISM
of iodine-131, effects of thyroid gland steady state function on, 16: 25105
of tritiated polyester in digestive mucous membrane in rat, 16: 25110 (CEA-2155)
METAL COATINGS
deposition on uranium and uranium dioxide particles, 16: 26479 (TID-7622(p.98-107))
METAL CRYSTALS
radiation effects on contact melting results, 16: 25868
tensile properties of single, apparatus for measurement of, 16: 25769(T) (SCL-T-434)
METAL-FOIL DETECTORS
design and performance for neutron flux distribution measurements, 16: 25562 (NP-11705)
METALLIC FOILS
charged-particle reactions with, gamma spectra from, 16: 26314
electron reactions with, gamma spectra from, 16: 26315
METALLURGY
chemical reactions of metals in formation of intermetallic compounds and solid solutions, 16: 25702(T) (AEC-tr-5182)
METALS
bibliography on boiling technology, 16: 25522 (ASD-TR-61-594)
corrosion by alkali metals at high temperatures, review, 16: 25714 (DMIC-169)
creep cavities, methods for metallographic examination of intergranular, 16: 25790
deformation, role of point defects in plastic, 16: 25764 (TID-16222)
electrostatic potential of spheres of, in interplanetary space, 16: 26050
heating by electron bombardment, 16: 26065 (AFCRL-975)
metallochemistry of intermetallic compounds and solid solutions, 16: 25702(T) (AEC-tr-5182)
preparation, properties, and uses of hard compounds of refractory, 16: 25768(T) (NASA-TT-F-102)
self-diffusion, method of predicting atomic mobility for, 16: 25816
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
thermionic emission, calculation of periodic deviations from Schottky effect in, 16: 25954 (TID-16225)
METEORITES
age estimation of iron, determined by ratio of potassium-40 to argon-40, 16: 25614 (JPL-TR-32-147)
analysis for iodine, tellurium, and uranium, neutron activation, 16: 25623
distribution of rare earths in, 16: 25648(R) (GA-2782(Rev.))
METEOROLOGICAL INSTRUMENTS
performance for measuring atmospheric turbulence, 16: 25611 (BNL-718)
METHACRYLIC ACID, METHYL ESTER
radioinduced copolymerization to styrene in ethylchloride, gamma, 16: 25458
METHANE
spectra of deuterium-labeled at 4430 to 4550 cm^{-1}, infrared, 16: 25345
METHANE, DICHLORODIFLUORO-
heat transfer in boiling, electroconvection effects on, 16: 25533
METHANOL
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354
METHANOL–NITRIC ACID SYSTEMS
solvent properties for rare earths, scandium, and yttrium, 16: 25280 (TID-15598)
METHIONINE
protective effects against radiation injuries in mice, 16: 25253
METHYL RADICALS
production of carbon-13 labeled, in hydrogenous materials, 16: 25419(R) (RRL-84)
reactions with hydrocarbons, effects of structure and medium, 16: 25335
MEXICO
fall-out monitoring, Feb. 1959 to Oct. 1961, 16: 25674
MICA
adsorptive properties for aluminum, 16: 26009
beta recoil of bismuth-212 and -214 from, 16: 26009
thermal desorption energies for bismuth and lead, 16: 26009
MICE
chemical protection against whole-body radiation, 16: 25252 (TID-16160)
effects of embryonic irradiation on adult life expectancy and pathology, 16: 25177(R) (TID-16129)
immunization by irradiated Sarcoma I ascites tumor, 16: 25108
radiation effects on population genetics, gonad exposure, 16: 25182(R) (TID-16323)
radiation effects in fetus after male exposure, protective effects of S-β-aminoethylisothiouronium against, 16: 25211
radiation effects on nucleic acid metabolism in, gamma and x, 16: 25212
radiation effects on eyes in developing embryos in pregnant, 16: 25215
radiation effects on nucleic acid metabolism in, protective effects of AET and MEA against, 16: 25255
radiation injuries in, protective effects of chemical agents against, 16: 25253
radioinduced anti-infection resistance in, protective effects of cysteine against, 16: 25258
MICROORGANISMS
incidence and virulence of *Chondrococcus columnaris* in Columbia River, 1960 and 1961, 16: 25145(R) (HW-72500(p.151-5))
MICROSCOPES
design of television, for automatic blood cell scanning, 16: 25568 (NYO-9644)
MICROSCOPY
development for analysis of inorganic materials, 16: 25275(T) (AEC-tr-5194)
MICROWAVE SPECTROMETERS
coupling to diaphragm-type waveguides, method description, 16: 26389(T) (FTD-TT-61-242(p.147-50))
performance in measurement of accelerator waveguide phase velocity, comparison of circuit types, 16: 26387(T) (FTD-TT-61-242(p.134-46))
MICROWAVES
absorption from and emission by plasma in magnetic fields, 16: 26418
interactions with plasma, resonance effects, 16: 26419
MILK
analysis for radioactivity, samples collected in northern Europe, 1961 and 1962, 16: 25167(R) (NP-11884)
levels of heavy radionuclides in, effects of plasma levels, 16: 25121(R) (HW-72500(p.44-9))
strontium-90 content in, due to fall-out, Canada, Jan.–March 1962, 16: 25616(R) (NP-11914)
strontium-90 content, from ingested strontium-90, 16: 25112(R) (HW-72500(p.1-12))
MINERALS

chlorine-36 oxidation states in neutron-irradiated, 16: 25443
hafnium–zirconium ratio in, 16: 25631
MITOSIS
biological model, 16: 25135(R) (HW-72500(p.104-8))
phases in transplanted Yoshida sarcomas, effects of fatty acid extracts from irradiated rabbits on, 16: 25228
radiation effects on, in Yoshida ascites sarcomas in rats, 16: 25220
radiosensitivity in developing sperm, 16: 25192
MIXERS
efficiency in mixing powders, 16: 25512(T) (NP-tr-887)
performance of ribbon-type, comparison with rotary-type, 16: 25514(T) (NP-tr-889)
MOLECULAR BEAMS
ionization with plasma ion source, 16: 26020
reactions with gases at high energies, forces in, 16: 26041
MOLECULES
book: *Atomic and Molecular Processes*, 16: 26024
charged particle reactions with, energy transfers in, 16: 26039
electron binding by, coefficients and cross sections for, 16: 26030
electron elastic scattering, 16: 26033
electron reactions, excitation and ionization from, 16: 26035
electron reactions, excitation and ionization cross sections for, 16: 26036
electron reactions, mass spectra calculations by critical slope method, 16: 25320 (TID-16157)
photoionization, 16: 26027
potential of systems of ions and dipolar, classical theory, 16: 26019
reactions, electron spin exchange in, 16: 25986
reactions, reliability of Hellmann-Feynman theorem for approximate charge densities in, 16: 25970
reactions with atoms and molecules, ionization in, 16: 26042
reactions with ions, excitation and ionization cross sections for, 16: 26036
reactions with ions, charge transfer and electron detachment in, 16: 26042
spectra, allowed transitions and probabilities for, 16: 26026
spectra, forbidden transitions in, 16: 26025
MOLTEN SALT REACTOR EXPERIMENT
kinetics of, computer analysis program for, 16: 26619 (ORNL-TM-203 (Add.))
MOLYBDATES
effects on copper metabolism, 16: 25151(R) (TID-16073)
MOLYBDENUM
coatings by anodic treatment and vapor deposition, 16: 25701 (WADD-TR-61-64)
conference on, University of Sheffield, Sept. 1960, 16: 25708
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)
corrosion, effects of surface saturation with silicon, 16: 25721(T) (FTD-TT-61-31(p.60-9))
determination in niobium and its alloys, 16: 25294
determination of ratio with uranium in hexafluoride mixtures, spectrometric, 16: 25313 (K-1433)
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
dislocation-relaxation spectra of cold-worked, 16: 25807 (GA-1745)
energy levels, isotopic shifts in, 16: 26360
fabrication of powders into crucible susceptors, 16: 25704
neutron capture cross sections, 16: 26509
neutron total cross sections at 10 to 1000 ev, 16: 25877(R) (ANL-6534)
paramagnetism of iron impurities in, 16: 25999
phase transition in alloyed and unalloyed, effects of interstitials on ductile-to-brittle, 16: 25751 (DMIC-Memo-155)
preparation and ductility of, scavenged with yttrium, 16: 25696(R) (DRI-2010)
properties in nitric acid solutions, 16: 25311 (IG-Memo-466)
radiation effects, 16: 26467(R) (HW-73100)
MOLYBDENUM ALLOYS
extrusion, 16: 25729(R) (ASD-TR-7-785(VI))
MOLYBDENUM BORIDES
thermodynamic properties at 300 to 1200°K, 16: 25401
MOLYBDENUM CARBIDE–URANIUM CARBIDE SYSTEMS
free energy of formation, 16: 25833
MOLYBDENUM FLUORIDE–URANIUM FLUORIDE SYSTEMS
analysis for molybdenum to uranium ratio, spectrometric, 16: 25313 (K-1433)
MOLYBDENUM FLUORIDES
reactions with nitrogen oxides, 16: 25339 (GAT-T-969)
MOLYBDENUM ISOTOPES Mo-93
production in niobium-93 decay, mass discrepancies from, 16: 26287 (IE-408)
MOLYBDENUM ISOTOPES Mo-95
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
MOLYBDENUM ISOTOPES Mo-100
energy level strength functions for, 16: 26518
MOLYBDENUM–NICKEL ALLOYS
diffusion in, effects of crystal deformation on, 16: 25831
MOLYBDENUM OXIDES
catalytic effects on recombination of gases in thorium oxide slurries, 16: 25407(P)
MOLYBDENUM–OXYGEN–TITANIUM–ZIRCONIUM SYSTEMS
phase studies, 16: 25826
MOLYBDENUM–PLUTONIUM–URANIUM ALLOYS
phase transformations at 350 to 500°C, 16: 25786
MOLYBDENUM–TITANIUM ALLOYS
atomic arrangements in solid solutions, 16: 25772 (NYO-7062)
MOLYBDENUM–TUNGSTEN ALLOYS
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)
MOLYBDENUM–URANIUM ALLOYS
corrosion during long-term storage, effects of coatings on, 16: 25713 (BMI-1563)
fabrication and properties, 16: 25735(R) (NMI-7251)
microstructure characteristics, 16: 25785
MONTE CARLO METHOD
accuracy comparison with known solution, 16: 25690 (RM-3184-PR)
MONTMORILLONITES
complexes with zirconium, fixation of phosphoric ions on, 16: 25305 (CEA-1650)
MOON
atmosphere and exploration, 16: 25094
atmosphere, properties, 16: 26049
MÖSSBAUER EFFECT
line broadening and transmission in, 16: 26225 (NP-11913)
MOTORS
power control of double-acting steam type, 16: 25539 (AD-269391)
MULTIPLICATION FACTOR
calculation of reactivity of central air gap in a bare reactor, 16: 26540
critical size and reactivity calculations, validity of the transport approximation, 16: 26539
effects of hydrogen on reactivity, 16: 26544
experimental results on large dilute fast critical systems with metallic and ceramic fuels, 16: 26524
reactivity coefficient calculation by perturbation theory, 16: 26543
MUTATIONS
in carcinogenesis, inherited and somatic, 16: 25106
induction in *Hemophilus influenzae*, 16: 25152(R) (TID-16075)
radioinduced by irradiation of males, in Drosophila, 16: 25192
radioinduced in Drosophila, doubling dose for, 16: 25210
radioinduced in Durum wheat, 16: 25195 (CNEN-126)
radioinduced in Durum wheat, 16: 25196 (CNEN-120)
radioinduced in tomatoes, 16: 25197 (CNEN-119)

N

NAPHTHALENE
radiolysis effects on hydrogen yield in deaerated petroleum high-boiling fractions, 16: 25416 (PAN-289/ChR)
spectra, modified Urey-Bradley force field for vibrational, 16: 25346
NATIONAL REACTOR TESTING STATION
health physics and safety analysis, 1961, 16: 25652(R) (IDO-12021)
NATURAL WATERS
radium and radon concentrations in Israel, 16: 25624
NECK
radiotherapy of non-malignant diseases of, cancer induction in, 16: 25201

NEODYMIUM
determination in silicate rocks, combined cation exchange-spectrochemical, 16: 25287
determination, micro-coulometric, 16: 25285
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
NEODYMIUM ETHYL SULFATES
gamma distribution from cerium-141 in, 16: 26242
NEODYMIUM OXIDES
thermodynamic properties, 16: 25386
NEON
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
vapor pressure of liquid and solid, 16: 25968
NEON ISOTOPES Ne-19
half life, 16: 26244
NEON ISOTOPES Ne-22
reactions with thorium-232 and uranium-238, production of actinium-225 and -226 from, 16: 25411 (JINR-P-978)
NEPTUNIUM
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
NEPTUNIUM(IV) IONS
diffusion coefficients in Dowex 1-X4 and Permutit SK anion exchange resins, 16: 25309 (DP-727)
NEPTUNIUM ISOTOPES Np-237
fission fragment measurements in strong backgrounds using nuclear emulsions, 16: 25558 (JINR-P-979)
metabolism of inhaled and ingested, 16: 25120(R) (HW-72500(p.41-3))
neutron fission cross sections at 10^3 to 10^7 ev, 16: 26525
neutron fission cross section, 16: 26505 (TID-13546)
toxicity, in inhaled dust, 16: 25124(R) (HW-72500(p.56-60))
transfer from plasma to milk, 16: 25121(R) (HW-72500(p.44-9))
NERVOUS SYSTEM
radiation effects on central, 16: 25235
radiation effects on higher, in prenatally exposed progenies, 16: 25236
radiation effects on, of animals irradiated during embryonic development, 16: 25237
radiation effects on, in rats irradiated during embryo genesis, 16: 25238
radiation effects on, of white rats exposed during embryonic period, 16: 25239
radiation effects on, of rat progenies exposed during late antenatal period, 16: 25240
radiation effects on, of rats chronically exposed prenatally, 16: 25241
radiation effects on, of rabbits exposed prenatally, 16: 25243
radiation effects on, of rats exposed prenatally, 16: 25245
radiation effects on, of prenatally exposed rats, 16: 25246
radioinduced changes in, of rabbits exposed prenatally, 16: 25242
radioinduced changes in, of prenatally exposed rabbits, 16: 25244
NEUTRINOS
charge of meson (μ)-associated, 16: 26115
interactions with nucleons, mesons (π) production in, 16: 26074 (JINR-P-905)
interactions with nucleons at high energies, boson nonproduction in, 16: 26130
interactions with hyperons and nucleons, vector current structure for, 16: 26184
production in meson (π) decay, properties, 16: 26147
reactions with nuclei at high energies, boson nonproduction in, 16: 26130
NEUTRON BEAMS
measurement of energy and line width of monochromatic, at 6.8 to 18 Mev, 16: 25589
production of polarized thermal, 16: 26198 (NP-11859)
production of polarized cold, resonance and thermal, 16: 26205
NEUTRON CAPTURE CROSS SECTIONS
calculation of, at 10^3 to 10^8 ev, 16: 26518
measurements at intermediate energies, 16: 26509
tables, 16: 26194 (JAERI-6010)
NEUTRON CROSS SECTIONS
calculation in fast reactors, 16: 26519
measurements in fast reactors, 16: 26506
punched card library of, 16: 26520
NEUTRON DECAY
heat transfer calculations for, 16: 26231 (TRG-Report-322)
NEUTRON-DIFFRACTION ANALYSIS
theory of double Bragg scattering by single crystals, 16: 26211
NEUTRON DIFFRACTOMETERS
design, 16: 25085 (JAERI-7022)
NEUTRON RESONANCE CROSS SECTIONS
Doppler broadening, 16: 26214 (AERE-M-1035)
NEUTRON SCATTERING CROSS SECTIONS
tables, 16: 26194 (JAERI-6010)
NEUTRON SPECTRA
extraction hole effects on thermal, 16: 26199 (NP-11932)
measurement at 2.34 to 10.4 kev using a chopper, 16: 25586
measurement of fast, using threshold-detector activation, 16: 26530
NEUTRON SPECTROMETERS
design and performance of scintillation, 16: 25549 (ASD-TDR-62-52)
design and performance of the JAERI crystal-type, 16: 25557 (JAERI-1030)
design and use of fast chopper for epithermal region, 16: 25586
design of diffractometer for crystalline samples, 16: 25593
NEUTRONS
absorption by nuclei at low energies, cross sections for fringe-area, 16: 26212
attenuation by iron-water shields, 16: 26192 (AEEW-R-125)
capture by cerium-144, resonance integral and thermal cross sections for, 16: 26294
charge form factor, 16: 25877(R) (ANL-6534)
detection and measurement, development of scintillation crystals for, 16: 25570 (TID-16107)
detection and measurement, frequency response of current ion chamber for, 16: 25587
detection and measurement methods for biological and physical applications, 16: 25594
diffusion and thermalization in finite moderating media, 16: 26206
diffusion and thermalization in hydrided Zircaloy-2, 16: 26207
diffusion, FICS program for calculating, 16: 26196 (KAPL-M-RPC-3)
diffusion of pulsed, extrapolation distances for, 16: 26208
diffusion, one-dimensional few-group code for, 16: 26195 (KAPL-M-CT-1)
distributions in shielding, development of hand calculations for, 16: 26432 (APEX-652)
effects on image orthicon and vidicon camera heads, 16: 25836 (AD-270724)
emission in mesons (π^-) capture by complex nuclei, 16: 25902 (LNF-62/37(p.138-42))
flux distribution gage for, 16: 25562 (NP-11705)
flux distribution in natural uranium, equilibrium, 16: 26529
flux in reactor, calculations by individual source-sink method, 16: 26500
from proton reactions (p,n) with nuclei at 14.8 Mev, 16: 26326 (UCRL-6733)
heating effects on materials, design of calorimeter for measuring, 16: 26502
interactions with protons, angular distributions of mesons (π^0) produced in, 16: 26082 (JINR-P-981)
interactions with deuterons at 0.5 to 1.0 Mev, polarization effects, 16: 26101
interactions with deuterons below 2 Mev, polarization effects, 16: 26102
interactions with protons at 350 Mev, meson (π)-nucleon coupling constant from, 16: 26105
interactions with protons at 128 Mev, triple-scattering parameters, 16: 26140
interactions with protons near 30 Bev, inelastic cross sections, 16: 26252
moderation at very low temperature, 16: 26193 (CEA-2012)
polarization measurement by mesons (μ^-) capture, 16: 25922 (NP-11977(p.49-52))
polarization methods for cold, resonance, and thermal, 16: 26205
production and escape in reactors, computer code for, 16: 26466 (GEMP-123)
reactions with molybdenum at 10 to 1000 ev, total cross sections, 16: 25877(R) (ANL-6534)
reactions with uranium-235, uranium-238, and plutonium-239, multiplication in, 16: 26241

reactions with uranium-238 at 14 Mev, fission-product energies from, 16: 26355
scattering at air-ground interface, Monte Carlo calculation of, 16: 26200 (ORNL-3287)
scattering by crystals, elastic resonance, 16: 26203(T) (AEC-tr-5145)
scattering by nuclei at A = 34 to 242, S- and P-wave strength functions, 16: 26334
scattering by single crystals, angular distributions of double Bragg, 16: 26211
scattering by tantalum at 2 to 300 kev, 16: 25877(R) (ANL-6534)
scattering of polarized, in helical magnetic structures, 16: 26188
slowing down density distribution in homogeneous media, computer program for analysis of, 16: 26197 (NAA-SR-7357)
slowing down, mathematical formalisms for, 16: 26209 (BNL-5821)
slowing down of (d,d), to 1.44 ev in paraffin wax, 16: 26210
transfers in aluminum, copper, gold, nickel, and tantalum bombardment with nitrogen-14 and -15, 16: 26221 (JINR-P-973)
transport equation for, Green functions for synthetic kernel, 16: 26201 (PAN-284/IX)
transport theory, multi-group, 16: 26538
transport theory, validity in critical size and reactivity calculations, 16: 26539

NICKEL
brazing to tungsten, 16: 25737 (WAL-TR-460.54/1-2)
crystallization temperature, effects of transition element binary solid solutions, 16: 25822
deformation, stored energy increase and release after, 16: 25821
determination in niobium and its alloys, 16: 25294
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
determination, micro-coulometric, 16: 25285
fracture under impulsive loading, 16: 25759 (NP-11890)
heat transfer and pressure drop in eccentric tubes, 16: 25526 (NYO-9649)
magnetic susceptibilities, 16: 25882 (ASD-TR-61-630)
neutron capture cross sections, 16: 26509
nitrogen-14 reactions, neutron transfer in, 16: 26221 (JINR-P-973)
properties, theory of infrared and optical, 16: 25758 (NP-11675)
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
wetting by liquid sodium, effects of additions of barium and calcium to sodium and of oxide films, 16: 25782

NICKEL ALLOYS
corrosion by high-temperature steam, 16: 26467(R) (HW-73100)
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)

NICKEL CHLORIDES
potentials of nickel electrodes in, 16: 25322 (TID-16292)

NICKEL COATINGS
performance on cadmium-indium-silver control rods, 16: 25796
protective effects against corrosion of thorium and uranium during long-term storage, 16: 25713 (BMI-1563)

NICKEL CRYSTALS
ferromagnetic behavior at low temperatures, 16: 25547 (AROD-2302.8)
magnetocrystalline anisotropy of single, 16: 25882 (ASD-TR-61-630)
neutron double Bragg scattering by single, angular distributions, 16: 26211

NICKEL ELECTRODES
potentials in alcohols, salt solutions, and water, 16: 25322 (TID-16292)

NICKEL ISOTOPES
proton reactions (p,n) at 17 Mev on even, effects of excited isobaric states, 16: 26333 (UCRL-6830)

NICKEL ISOTOPES Ni-58
gamma emission, analysis of collective E3 and E4, 16: 26271
proton inelastic scattering at 7 to 8 Mev, proton polarization from, 16: 26290
proton reactions (p,d), distributions from, 16: 26258
proton scattering by, polarization in inelastic, 16: 26226 (NYO-10131)

NICKEL ISOTOPES Ni-59
deuteron elastic scattering, absorptive effects in, 16: 26342

NICKEL ISOTOPES Ni-60
gamma emission, analysis of collective E3 and E4, 16: 26271
proton scattering at 30.8 Mev, angular distributions, 16: 26282

NICKEL ISOTOPES Ni-61
magnetic moment, 16: 26322

NICKEL OXIDES
reactions with uranium oxides at high pressure and 900 to 1200°C, 16: 25302 (BMI-1585)

NICKEL SULFATES
potentials of nickel electrode in, 16: 25322 (TID-16292)

NICKEL–ZIRCONIUM ALLOYS
phase diagram, 16: 25819

NIOBIUM
analysis, 16: 25294
coating with calcium titanates, endurance properties of, 16: 25761(R) (PWA-2088)
coatings by anodic treatment and vapor deposition, 16: 25701 (WADD-TR-61-64)
conference on, University of Sheffield, Sept. 1960, 16: 25708
corrosion by impurities in liquid metal coolant in Dounreay Fast Reactor, 16: 26475 (TID-7622(p.35-56))
corrosion, effects of surface saturation with silicon, 16: 25721(T) (FTD-TT-61-31(p.60-9))
determination in presence of tantalum, polarographic, 16: 25290
determination in titanium alloys, gravimetric, 16: 25269 (NP-11834)
dislocation-relaxation spectra of cold-worked, 16: 25807 (GA-1745)
mechanical properties, effects of hydrogen pickup, 16: 25402
metallurgical effects on tensile properties of carbon steel, 16: 25792
metallurgical effects on tensile properties of medium-carbon steel, 16: 25811
metallurgical effects on properties of aluminum–titanium-zirconium alloys, 16: 25813
neutron capture cross sections, 16: 26509
neutron resonance absorption integrals for, 16: 26511
neutron scattering, fast, 16: 26505 (TID-13546)
phase transition in alloyed and unalloyed, effects of interstitials on ductile-to-brittle, 16: 25751 (DMIC-Memo-155)
separation from tantalum by solvent extraction with hydrofluoric acid–sulfuric acid–methyl isobutyl ketone, 16: 25492
sorptive properties for hydrogen in potassium–sodium alloy at 350°C, 16: 25402

NIOBIUM ALLOYS
analysis, 16: 25294
corrosion by steam at 1000 to 1300°, additive optimization, 16: 25695(R) (BMI-X-188)

NIOBIUM BORIDES
thermodynamic properties at 300 to 1200°K, 16: 25401

NIOBIUM CRYSTALS
hardness anisotropy, 16: 25818

NIOBIUM ISOTOPES Nb-91
energy levels, excitation energies and spins for, 16: 26287 (IS-408)

NIOBIUM ISOTOPES Nb-93
beta decay, mass discrepancies from, 16: 26287 (IS-408)
energy level strength functions for, 16: 26518
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)

NIOBIUM ISOTOPES Nb-94
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356

NIOBIUM OXIDES
heat of formation, 16: 25334

NIOBIUM–TIN ALLOYS
phase studies of superconducting, 16: 25791

NIOBIUM–ZIRCONIUM ALLOYS
fatigue, effects of applied stress and hydrogen sorption on static, 16: 25746(R) (ARF-2230-9)

NITRIC ACID
solvent partition in tributylphosphate systems, 16: 25489
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
solvent properties for thorium dicarbide at room temperature and 80°C, 16: 25365
solvent properties for molybdenum, 16: 25311 (IG-Memo-466)

NITRIC ACID–SULFAMIC ACID SYSTEMS
solvent properties for plutonium, 16: 25310 (DP-737)

NITRIDES
preparation, properties, and uses of refractory-metal, 16: 25768(T) (NASA-TT-F-102)
properties of high-melting, 16: 25835

NITRITE IONS
determination at low concentration using potassium permanganate, amperometric titration, 16: 25272(R) (TID-16332)
interactions with phonons in potassium chloride crystals at 1 to 100°K, 16: 25996
NITROGEN
corrosive effects on niobium and vanadium at operating conditions of Dounreay Fast Reactor, 16: 26475 (TID-7622(p.35-56))
determination in niobium and its alloys, 16: 25294
diffusion and solubility in beryllium, 16: 25757(R) (NMI-9815)
formation in swimming pool reactors, 16: 26495(T) (TID-7622(p.310-15))
heat transfer in boiling, electroconvection effects on, 16: 25533
liquid level control in Dewar flask, method for, 16: 25413(R) (NP-11882)
neutron total cross sections at 0.01 to 10 kev, 16: 25586
reactions with graphite at 2300°K, 16: 25394
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
reactions with helium ions at 300 to 1500 kev, electron loss in, 16: 26021
reactions with helium, ionization cross sections, 16: 26238
reactions with nitrogen oxide and nitrogen-15, 16: 25362
scavenging in molybdenum and tungsten preparation, 16: 25696(R) (DRI-2010)
sorption effects on ductile-to-brittle transition in alloyed and unalloyed refractory metals, 16: 25751 (DMIC-Memo-155)
stopping power for recoil ions from alpha reactions (α,n), 16: 26243
thermodynamic properties at high temperatures, review, 16: 25300 (ARL-62-358)
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
NITROGEN ISOTOPES N-14
hyperfine structure in, 16: 26318
reactions with aluminum, copper, gold, nickel, and tantalum, neutron transfer in, 16: 26221 (JINR-P-973)
reactions with uranium-238, production of actinium-225 and -226 from, 16: 25411 (JINR-P-978)
NITROGEN ISOTOPES N-15
exchange in reactions, of active nitrogen with nitric oxide, 16: 25362
hyperfine structure in, 16: 26318
reactions with aluminum, copper, gold, nickel, and tantalum, neutron transfer in, 16: 26221 (JINR-P-973)
NITROGEN ISOTOPES N-16
half life, 16: 26213 (AE-78)
NITROGEN ISOTOPES N-17
production in nitrogen-14 and -15 reactions with aluminum, copper, and tantalum, 16: 26221 (JINR-P-973)
NITROGEN OXIDES
determination in clouds and precipitation on Zugspitzplatt August 15 to September 21, 1955, 16: 25625
reactions with active nitrogen, tracer studies, 16: 25362
reactions with molybdenum, tungsten, and uranium hexafluorides, 16: 25339 (GAT-T-969)
NOZZLES
for gaseous isotope separation, theory, 16: 25687(T) (AEC-tr-5069)
NRU REACTOR
maintenance scheduling, PERT program for, 16: 25081 (CRIO-1091)
safety in operation procedures for, 16: 26614 (AECL-1486)
NRX REACTOR
safety in operation procedures for, 16: 26614 (AECL-1486)
NUCLEAR BATTERIES
design and characteristics, review, 16: 25667
design for direct conversion of fission heat to electric energy, 16: 25972
NUCLEAR CHEMISTRY
conference on nuclear reactor chemistry, Gatlinburg, Tenn., October 10 to 12, 1961, 16: 26472 (TID-7622)
research programs at Hahn-Meitner Institute for Nuclear Research, 1961, 16: 25083 (HMI-B-22)
NUCLEAR EMULSIONS
background-insensitive, for fission studies, 16: 25558 (JINR-P-979)
elementary particle scattering, effects of higher order differences in measurements on reduction of spurious, 16: 26090 (NYO-10233)
meson (K^-) capture in, effects of nuclear mass, 16: 26084 (NP-11623)
processing, design of apparatus for, 16: 25504 (PAN-293/1-A)
properties in accelerator experimentation, 16: 25907 (LNF-62/37 (p.180-3))
NUCLEAR MAGNETIC RESONANCE
signal fine structure, nutation in, 16: 25965(T) (JPRS-13656(p.260-78))
NUCLEAR MODELS
comparison of cluster, shell, and unified, for 1p-shell nuclei, 16: 26247
energy levels of beryllium-9 in cluster, 16: 26272
spectra in, effects of collective excitations on single-particle, 16: 26269
unified description of collective-shell vibrations, 16: 26277
NUCLEAR MODELS (OPTICAL)
collective potential in, effects on S- and P-wave strength functions, 16: 26334
complex effective mass in calculation of the optical model potential, 16: 26229 (PAN-304/VII)
deuteron stripping reaction parameters in, 16: 26300
fringe absorption relation to neutron strength function, 16: 26212
potentials in, dependence on isobaric spin, 16: 26285
NUCLEAR MODELS (SHELL)
energy levels in, studies using (p,d) pickup reactions, 16: 26258
energy levels of lithium-6 in intermediate-coupling, 16: 26276
proton momentum distributions in, 16: 26273
NUCLEAR PHYSICS
book: *Landolt-Bornstein Numerical Data and Functional Relationships in Science and Technology. New Series. Vol. 1, Energy Levels of Nuclei: A = 5 to A = 257*, 16: 26366
book: *The Theory of Fundamental Processes*, 16: 26453
decay of quantum system, theory of spontaneous, 16: 25964(T) (JPRS-13656(p.233-59))
development of, review of progress at Warsaw Center in, 16: 25950 (PAN-279/I-A)
experimental and theoretical studies on particle reactions, 16: 25910(R) (NP-11749)
research programs, 16: 25886 (LNF-62/37)
research progress at Purdue Research Foundation, 16: 25953(R) (TID-16079)
NUCLEAR POWER PLANTS
book: *Thermal Power Engineering for Nuclear Installations*, 16: 26605(T) (FTD-TT-61-241)
cost factors for British designs, 16: 26606
design and performance of compact thermionic, for space applications, 16: 26598 (NAA-SR-7144)
design with constant coolant temperature at reactor inlet, 16: 26611(P)
NUCLEAR REACTIONS
amplitudes above the Bev region, "multicenter" peripheral model for, 16: 26116
analysis of breakup, using approximate model, 16: 26270
analysis of (p,d) pickup, for studies of filled shell model states, 16: 26258
angular correlations in particle emission, effects of statistical perturbations, 16: 26250
angular distribution data for, computer program for analysis of, 16: 26227 (ORNL-3251)
deuteron stripping, effects of spin-orbit distortion, 16: 26284
of protons (p,n), effects of isobaric spins on, 16: 26285
properties at 3×10^{14} ev, of cosmic particles on nuclei, 16: 26296
protons at 3 to 25 Bev, cross sections, 16: 26274
research progress at Purdue Research Foundation, 16: 25953(R) (TID-16079)
resonant particle transfer in elastic, 16: 26299
statistical emission in, 16: 26516
theory of many-channel, 16: 26345
NUCLEAR SPECTRA
effects of collective excitations on single-particle, 16: 26269
research progress at Purdue Research Foundation, 16: 25953(R) (TID-16079)
NUCLEAR SPIN
dynamics of ferromagnetic, 16: 26013
wave properties in magnetites, 16: 25979
NUCLEAR STRUCTURE

five-body problem in, independent pair model of, 16: 26452
NUCLEAR TECHNOLOGY
inert atmosphere production and uses in, 16: 25517
NUCLEAR THEORY
book: *Perturbation Theory and the Nuclear Many Body Problem*, 16: 26023
complex effective mass in calculation of the optical model potential, 16: 26229 (PAN-304/VII)
energy levels of N-particle quantum systems in, 16: 26441
fission-threshold and fragment-excitation energies, 16: 26361
isotopic spin validity as quantum number in, for large Z, 16: 26304
nucleon potentials without hard cores in, 16: 26251
of even-even nonspherical nuclei, precision of Bogolyubov method, 16: 26218 (JINR-P-923)
solutions of Yang-Mills field, static and spherically symmetric, 16: 26449
NUCLEI
antineutrino and neutrino reactions at high energies, boson non-production in, 16: 26130
cosmic-particle reactions at 3×10^{14} ev in emulsion, 16: 26296
decay and particle emission, effects of statistical perturbations on angular correlations, 16: 26250
decay, angular correlation and Mössbauer effect studies, 16: 25953(R) (TID-16079)
description of rotating, 16: 26305
deuteron scattering on nonspherical, deformation of arbitrary multipolarity from, 16: 26228 (PAN-300/VII)
deuteron stripping on non-axial, 16: 26350
electron scattering, effects of charge on bremsstrahlung emission in, 16: 26348
energy-level spectra, higher-random-phase approximation for spherical, 16: 26330
energy levels and transitions for A = 5 to 257, tables, 16: 26366
energy levels of odd-A, study by Coulomb excitation, 16: 26230 (TID-16058)
equilibrium shapes of, in quasistatic fission model, 16: 26358
gamma and proton reactions at (0.5 to 2.0) $\times 10^9$ °K at 10^{-5} to 10^3 gm cm^{-3}, rates of, 16: 26341
gamma emission by spherical, analysis of collective E3 and E4, 16: 26271
gamma emission by compound, at high angular momenta, 16: 26364
gamma reactions, boson production cross sections for, 16: 26362
gamma reactions, mesons (π^0) photoproduction in, 16: 25893 (LNF-62/37(p.57-71))
giant E1 resonance in deformed, analysis by random-phase approximation, 16: 26253
half lives, evaluation of time correlation method of measurement, 16: 26215 (AROD-2543.5)
isobaric excited states in medium-A, non-mirror, even, 16: 26333 (UCRL-6830)
isotopic spin of heavy, validity as quantum number, 16: 26304
meson (K^-) capture by, effects of atomic weight, 16: 26084 (NP-11623)
meson (K^-) reactions, $_4Be^7$ production in, 16: 26312
meson (μ^-) capture by, photon angular distributions from, 16: 26236
mesons (μ) photoproduction in Coulomb field of, 16: 25931 (NP-11977(p.90-2))
mesons (π) reactions with, nucleon pair production in, 16: 26089 (NP-11832)
mesons (π) reactions in heavy, 16: 26340
mesons (π^-) capture by complex, neutron spectrum from, 16: 25902 (LNF-62/37(p.138-42))
neutron scattering at high energies by light, resonance, 16: 26521
neutron scattering, S- and P-wave strength functions for A = 34 to 242, 16: 26334
nucleon conservation, 16: 26328
photon reactions with heavy, 16: 25949 (NP-11977(p.144-6))
proton reactions with, mesons (π) and strange particle production in, 16: 26089 (NP-11832)
quadrupole oscillations of spherical, anharmonic effects of, 16: 26359
vibrations of, description of collective, using shell model wave functions, 16: 26277
NUCLEIC ACIDS
protective effects against radiation injuries in mice, 16: 25253
radiation effects on metabolism in mice, gamma and x, 16: 25212
radiation effects on metabolism in spleen, testis, and thymus in mice, protective effects of AET and MEA against, 16: 25255
NUCLEONS
electromagnetic form factors for, 16: 25896 (LNF-62/37(p.81-8))
electromagnetic form factors at high energies, 16: 26133
gravitational wave emission by, 16: 26176
interactions at 95 to 310 Mev, triplet-even potentials for, 16: 26126
interactions, potentials without hard cores for, 16: 26251
interactions with mesons (K) and nucleons, cross sections, 16: 25877(R) (ANL-6534)
interactions with nucleons at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions with antinucleons at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions with mesons (π), regularization of equations for, 16: 26072 (JINR-P-891)
interactions with neutrino, mesons (π) production in, 16: 26074 (JINR-P-905)
interactions with mesons (π), 16: 26076 (JINR-P-938)
interactions with mesons (π), dispersion relations for, 16: 26077 (JINR-P-949)
interactions with mesons (π^-) at 7 Bev, properties of mesons (π^0) formed in inelastic, 16: 26081 (JINR-P-974)
interactions with mesons (π), form factors for, 16: 26089 (NP-11832)
interactions with hyperons and mesons (K), form factors for, 16: 26089 (NP-11832)
interactions with hyperons and nucleons, global symmetry and scattering, 16: 26091 (NYO-10234)
interactions with photons, meson (π) photoproduction amplitude integral equations, 16: 26094
interactions with mesons (π), coupling constant for, 16: 26105
interactions with antinucleons and hyperons (Λ), dispersion relations, 16: 26110
interactions with antineutrinos and neutrinos at high energies, boson nonproduction in, 16: 26130
interactions with mesons ($\bar{K}$), S-wave scattering amplitudes, 16: 26137
interactions with mesons (π), vertex function in, 16: 26144
interactions with nucleons at 3.3 to 7.8 Bev/c, total cross sections for, 16: 26145
interactions with mesons (π), complex angular momentum plane singularities in, 16: 26153
interactions with mesons (K^-), resonances from, 16: 26161
interactions with hyperons (Λ), heavy-meson single exchange force in, 16: 26165
interactions with mesons (π), amplitude relation to π-σ amplitudes, 16: 26169
interactions with bosons, meson multiple production in, 16: 26170
interactions with mesons (π), meson (π) production in, 16: 26174
interactions with mesons (ω), coupling constant for, 16: 26175
interactions with nucleons in nuclear matter, complex effective mass in optical potential model scattering, 16: 26229 (PAN-304/VII)
interactions with mesons and nucleons at high energies, spin amplitude in, 16: 26191
interactions with mesons (π) and nucleons in heavy nuclei, 16: 26340
interactions with hyperons (Λ), spin dependence of, 16: 26344
magnetic moments of, meson (η), (ω), and (ρ) effects on, 16: 26164
pair production in mesons (π) reactions with nuclei, 16: 26089 (NP-11832)
production of pairs by photons, open cosmological model for multiple, 16: 26097
stability measurements, 16: 26328

O

OCTANE
radioinduced crosslinking by ultraviolet light in presence of sensitizers, 16: 25455
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
OLEIC ACID
radiomimetic action on irradiated yeast cells, effects of oxygen, 16: 25200
ORGANIC COMPOUNDS

hydrogen isotope exchange and replacement in, book, 16: 25372(T)
labeling with fluorine-18 produced by oxygen-16(t,n) reactions, 16: 25432
preparation of aliphatic secondary or tertiary thiol- primary amino- hydrochlorides and cyclic ketone derivatives, 16: 25249(R) (NP-11740)
radiation effects on electrically insulating, electron, 16: 25855
radiation effects on Brazilian peppermint oil, 16: 25450
ORGANIC COMPOUNDS, METALLO-
decomposition, 16: 25308 (DMIC-170)
ORGANIC COOLED REACTORS
coolant research program for DON, 16: 25312 (JEN-90-DQ/1-24)
ORGANIC MODERATED REACTOR EXPERIMENT
fuel element ultrasonic cleaning, 16: 25700(R) (NYO-10282)
ORGANIC MODERATED REACTORS
fuel element design, concentric tubular, 16: 26571(P)
ORGANS
fission product permissible limits for, 16: 25643 (CEA-2163)
uranium content in rabbit, from inhalation and injection, 16: 25158
ORNL GRAPHITE REACTOR
radioinduced heating in, design of calorimeter for measuring, 16: 26502
ORNL RESEARCH REACTOR
fuel cycles and loading programming for, 16: 26620 (ORNL-TM-277)
safety measures for control of personnel exposures and contamination, 16: 25654 (ORNL-TM-278)
OROTIC ACID
protective effects against radiation injuries in mice, 16: 25253
protective effects against radiation injuries in rabbits, 16: 25257
OSCILLATORS
scintillation effects in valve auto-, 16: 25579 (CEA-2028)
OSMIUM
spectrum of, isotopic shifts in, 16: 26317
OSMIUM ISOTOPES Os-188
energy levels of, from iridium-188 decay, 16: 26286
OXIDASES
inhibitors of monoamine, protective effects against whole-body radiation in mice, 16: 25252 (TID-16160)
OXIDE FILMS
nucleation and growth, 16: 25716 (NP-11876)
OXIDES
vaporization rate measurement, 16: 25403
volatile, methods for studying, 16: 25381
OXYGEN
corrosive effects on niobium and vanadium at operating conditions of Dounreay Fast Reactor, 16: 26475 (TID-7622(p.35-56))
determination in niobium and its alloys, 16: 25294
determination in titanium by gas fusion and vacuum fusion techniques, 16: 25269 (NP-11834)
determination of dissolved, in water by radiometric analysis, 16: 25282
diffusion and solubility in beryllium, 16: 25757(R) (NMI-9815)
effects on oleic acid action on irradiated yeast cells, 16: 25200
formation in swimming pool reactors by radiolysis of water, 16: 26495(T) (TID-7622(p.310-15))
mesons (μ) transfer in mesic, 16: 26219 (JINR-P-942)
oxidation of beryllium above 500°C, 16: 25725
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
reactions with helium, ionization cross sections, 16: 26238
reactions with hydrogen in thorium oxide--uranium oxide slurries, use of molybdenum oxide catalyst in, 16: 25407(P)
reactions with lithium at 78 to 300°K, 16: 25727
scavenging in molybdenum and tungsten preparation, 16: 25696(R) (DRI-2010)
solubility in thorium oxide and water slurries, 16: 25324 (TID-16392)
sorption effects on ductile-to-brittle transition in alloyed and unalloyed refractory metals, 16: 25751 (DMIC-Memo-155)
thermodynamic properties at high temperatures, review, 16: 25300 (ARL-62-358)
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)
OXYGEN IONS
scattering by argon and xenon at 153 Mev, elastic, 16: 25990
OXYGEN ISOTOPES O-16
energy level calculations based on particle-hole interactions, 16: 26303
energy-level spectra at 6.06 Mev, higher-random-phase approximation for, 16: 26130
excited states, properties of first, 16: 26343
gamma decay of 6.92- and 7.12-Mev states, branching ratios for, 16: 26301
gamma decay of 7.12-Mev state, branching ratios for, 16: 26298
neutron activation cross sections at 14.7 Mev, 16: 26268
neutron scattering, fast, 16: 26505 (TID-13546)
proton elastic scattering at 4.25 to 8.6 Mev, differential cross sections for, 16: 26324
proton elastic scattering at 4.25 to 8.6 Mev, differential cross sections for, 16: 26323
OXYGEN ISOTOPES O-17
energy level parameters for, 16: 26324
triton reactions (t,p) to 2.73 Mev, cross sections for, 16: 26291
OXYGEN ISOTOPES O-19
half life, 16: 26213 (AE-78)
production in triton reactions (t,p) with oxygen-17 to 2.73 Mev, 16: 26291
OXYGEN--TITANIUM SYSTEMS
thermodynamic properties of oxygen in, 16: 25384
OXYGEN--URANIUM SYSTEMS
equilibrium oxygen pressures, 16: 25373
phase studies, 16: 26483 (TID-7622(p.139-48))
thermodynamic properties, 16: 25377
OXYGEN--WATER SYSTEMS
reactions with hafnium and zirconium borides and carbides at 3000°K, kinetics and thermodynamics, 16: 25747 (ASD-TDR-62-204(Pt.I))
OXYGEN--ZIRCONIUM SYSTEMS
thermodynamic properties of oxygen in, 16: 25384

P

PACKAGING
contamination by dry fall-out, 16: 25656 (USNRDL-TR-557)
for radiosterilized foods, bibliography on requirements, 16: 25681 (TID-15144)
PACKED COLUMNS
efficiency of 0.5 inch-diameter, for distillation of bromine pentafluoride-uranium hexafluoride system, 16: 25467 (ANL-6362)
heat and mass transfer through fixed and fluidized beds in, 16: 25532
PALLADIUM
brazing to tungsten, 16: 25737 (WAL-TR-460.54/1-2)
mesic atoms, mesons (μ^-) decay in, 16: 26080 (JINR-P-972)
neutron capture cross sections, 16: 26509
paramagnetism of iron impurities in, 16: 25999
PALLADIUM HYDRIDES
mesic atoms, mesons (μ^-) decay in, 16: 26080 (JINR-P-972)
PALLADIUM ISOTOPES Pd-99
production in rhodium-99 decay, mass discrepancies from, 16: 26287 (IS-408)
PALLADIUM ISOTOPES Pd-105
energy levels and gamma spectra, 16: 26295
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
PALLADIUM ISOTOPES Pd-108
energy level strength functions for, 16: 26518
PANCREAS
visualization after administration of selenomethionine-selenium-75, radiometric, 16: 25097(R) (TID-16081)
PANTOTHENIC ACID
protective effects against radiation injuries in mice, 16: 25253
PARAFFIN
neutron slowing down to 1.44 ev in, from (d,d) reaction, 16: 26210
radioinduced crosslinking by ultraviolet light in presence of sensitizers, 16: 25455
PARATHYROID EXTRACTS
effects on radiation injuries, 16: 25251(R) (TID-16159)
PARTICLE TRACKS
delineation in large silver chloride crystals, 16: 25546 (AFOSR-3030)
PARTICLE TRAJECTORIES
in linear electron accelerators, 16: 26379(T) (FTD-TT-61-242(p.22-32))
PEACH BOTTOM POWER REACTOR
fission-product trapping system for, design studies, 16: 26489 (TID-

7622(p.218-35))
fission product trapping system for, computer program for analysis of transient performance of, 16: 26593 (GAMD-3168)
PENTANE, 3-METHYL-
separation from deuterated isomers by partition chromatography, 16: 25427
2,4-PENTANEDIONE
photolysis in liquid butadiene, 16: 25419(R) (RRL-84)
PENTANES
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
radiolysis products of iso-, n-, and neo-, yields of, 16: 25421 (WADD-TR-61-38)
PERCHLORIC ACID
concentration effects on isotopic exchange between cobaltic and cobaltous systems, 16: 25353
PEROVSKITES
magnetic exchange and structure in lanthanum manganite, 16: 25882 (ASD-TR-61-630)
PERSONNEL
metering at National Reactor Testing Station, 16: 25652(R) (IDO-12021)
radiation effects of electromagnetic fields in tuning and testing of radio engineering instruments, 16: 25662(T) (JPRS-13691(p.20-4))
radiation effects on abortion, infant death, and sterility in x-ray, in Japan, 16: 25214
PERTURBATION THEORY
application to scattering amplitudes, expansion integral representation for, 16: 26437
book: *Perturbation Theory and the Nuclear Many Body Problem*, 16: 26023
reactor reactivity coefficient calculation by, 16: 26543
PETROLEUM
radiolysis of deaerated high-boiling fractions of, hydrogen yield and naphthalene effects on, 16: 25416 (PAN-289/ChR)
PHANTOMS
preparation of brain and brain tumor, 16: 25102
PHENOL, DINITRO-
effects on calcium metabolism in plants, 16: 25140(R) (HW-72500 (p.128-33))
PHOSPHATE IONS
equilibrium effects on anionic XX resin and uranyl sulfates, 16: 25330
PHOSPHATES
determination in blood serum ultrafiltrates, 16: 25115(R) (HW-72500 (p.19-22))
PHOSPHINES
neutron capture in gaseous, effects on bonds of, 16: 25454 (BNL-4850)
PHOSPHONIC ACIDS
2-ethylhexylphenyl-, solvent properties for transcurium elements, 16: 25477 (ORNL-3273)
PHOSPHORIC ACID, ALKYL ESTERS
solvent properties for beryllium in sulfate solutions, 16: 25475 (NCL/AE-172)
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
PHOSPHOROUS ACID
hydrogen isotope exchange and oxidation in strong acid solutions, 16: 25631
PHOSPHORS
development for neutron dosimetry, 16: 25570 (TID-16107)
fluorescence of samarium-activated, 16: 25974
PHOSPHORUS
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
neutron activation on paper chromatograms for biochemical analyses, 16: 25289
neutron scattering at 3.4 to 4.6 Mev, angular distributions, 16: 26507
PHOSPHORUS IONS
fixation on montmorillonite-zirconium, 16: 25305 (CEA-1650)
PHOSPHORUS ISOTOPES P-31
energy level lifetimes, from resonance scattering of beemsstrahlung, 16: 26275
neutron activation cross sections at 14.7 Mev, 16: 26268
neutron reactions (n,γ) in, effects on bonds in trimethylphosphine of, 16: 25454 (BNL-4850)
PHOSPHORUS ISOTOPES P-32
analysis for contaminations in humic preparations, spectrometric, 16: 25448
beta decay, beta longitudinal polarization in, 16: 26259
distribution and excretion, dose relation to, 16: 25163
excretion of injected, in liver bile in rabbits, 16: 25156
injections, effects on blood cells in bone marrow and lymph in rabbits, 16: 25202
uptake by subcutaneous connective tissue, 16: 25164
PHOTOFISSION
research program at Naples, 16: 25900 (LNF-62/37(p.115-17))
PHOTOGRAPHIC FILM DETECTORS
design for measuring dose of high-energy radiation, 16: 25574(T,P) (AEC-tr-5193)
image fading in, latent, 16: 25645 (CLOR-11)
properties as dosimeter, 16: 25658(T) (AERE-Trans-895)
PHOTOMULTIPLIER TUBES
development in USSR, 16: 25567 (NP-11947)
PHOTON SPECTRA
production of quasi-monochromatic, by 1-Bev electron reactions on diamond, 16: 26136
PHOTONS
angular distributions from meson (μ^-) capture by nuclei, 16: 26236
detection of, from mesons (π^0) photoproduction, 16: 25936 (NP-11977(p.102-4))
interactions with nucleons, meson (π) photoproduction amplitude integral equations, 16: 26094
multiple nucleon pair production by, open cosmological model for, 16: 26097
production of polarized beam, 16: 25932 (NP-11977(p.93-4))
properties in S-matrix theory, nonelementarity, 16: 26139
PHOTOSYNTHESIS
of chlorophylls, tracer study, 16: 25155
PHYSICS
anomalous skin effects in Fermi fluids, charged-particle interaction effects on, 16: 26017
gasdynamic study of Riemann waves, 16: 26436(T) (FTD-TT-62-354)
research progress at Brown Univ. on high-energy, 16: 25952(R) (TID-16011)
translation of *Izvestiya Vysshikh Uchebnykh Zavedenii, MVO*, Vol. IV, No. 5, 1961 on radiophysics, 16: 25958(T) (JPRS-13656)
PINCH EFFECT
formation of cylindrical, mechanisms for early-stage, 16: 26421
PISTON ENGINES
wear studies, tracer techniques in, 16: 25682(R) (TID-16013)
PLANETS
atmosphere and exploration, 16: 25094
PLANT CELLS
radiation effects on metabolism, 16: 25135(R) (HW-72500(p.104-8))
radioinduced chromosome breakage in interphase root meristems, 16: 25217
PLANT METABOLISM
effects of dinitrophenol on transpiration and calcium accumulation, 16: 25140(R) (HW-72500(p.128-33))
of arsenates, effects of soil composition, 16: 25138(R) (HW-72500 (p.119-22))
of calcium and rubidium, effects of chloramphenicol, 16: 25139(R) (HW-72500(p.123-7))
radiosensitivity, 16: 25135(R) (HW-72500(p.104-8))
PLANTS
absorption of cesium-137 and strontium-90 by cultivated, 16: 25642 (CEA-2159)
beta radioactivity and potassium content in, 16: 25644 (CLOR-9)
forage yields from lichens, arctic sedge, and cheatgrass, 16: 25147(R) (HW-72500(p.159-60))
localization of β-indolylacetic acid in plant cells and tissues, tracer study, 16: 25103
monitoring for radioactivity at Paducah Plant, 1961, 16: 25653 (KY-419)
radioinduced mutations in tomatoes, 16: 25197 (CNEN-119)
use of pine needles as monitor of radioactive pollution, 16: 25644 (CLOR-9)
PLASMA

acceleration by rail-type electromagnetic devices, analysis of energy efficiency, 16: 26367 (AFOSR-1631)
acceleration in magnetic annular shock tube, 16: 25912 (NP-11848)
anomalous skin effects in Fermi fluids, charged-particle interaction effects on, 16: 26017
charged particle beam stability in, 16: 26397 (AD-269051)
containment and scattering loss reduction by, 16: 26408
dielectric constant of dense, calculation of, 16: 25875 (AFSWC-TDR-62-21)
dielectric constant, charge-separation effects on, 16: 26410
dielectric constant of, complex, 16: 26423
electric conductivity and temperature, effects of electrostatic instabilities, 16: 25962(T) (JPRS-13656(p.177-92))
electric conductivity of cold, at high current densities, 16: 26412
electric microfield distribution functions in, at high temperatures, 16: 26429
electromagnetic radiation from plane turbid layers, 16: 26425
electromagnetic-wave gradient effects on, 16: 26183
electromagnetic wave excitation and propagation in, 16: 26401 (JINR-P-917)
electron oscillations and concentration patterns in, 16: 26411
heating, 16: 26409
impedance between conducting parallel plates, 16: 25552 (D1-82-0173)
instrumentation of dense, theory of probe, 16: 26405 (UCRL-10128)
interaction with electromagnetic fields, 16: 26051
interactions with microwaves, resonance effects, 16: 26419
interactions with electron beams, hydrodynamic approximation, 16: 26424
kinetic theory of rapidly variable processes in, 16: 26406(T) (NP-tr-883)
magnetohydrodynamic equations for, 16: 26420
microwave absorption and emission by, in magnetic fields, 16: 26418
motion across magnetic fields, analysis of, 16: 26414 (UCRL-6294)
motion in magnetic fields, 16: 26402 (JINR-P-929)
nonbonding interactions in partially ionized, 16: 25875 (AFSWC-TDR-62-21)
oscillations, collision damping mechanisms, 16: 26416
oscillation excitation by cesium ions in, low-frequencies, 16: 26427
oscillations in, mechanisms and stability, 16: 26407
oscillations of one-dimensional unstable cold, mathematical analysis, 16: 26431
oscillations, theory of Landau damping of electrons, 16: 26413
particle friction in, kinetic equation for dynamic, 16: 26426
production for reentry simulation, design of ARGMA 8000-kw facility for, 16: 25499 (ARGMA-TN-2HSN)
production of hot dense, in electron reactions, 16: 26417
propagation of one-dimensional, in field-free space, 16: 26430
properties of injected electron-hole, effects of longitudinal magnetic fields, 16: 26400 (D1-82-0172)
radar cross-section of low-density shapes, 16: 26396 (AD-268824)
radiation emission, bremsstrahlung and cyclotron, 16: 25879 (ARL-62-320)
reactions with charged particle beams in magnetic fields, nonlinear theory, 16: 26428
spectral-line broadening in, 16: 26037
stability, effects of high-frequency electromagnetic disturbances, 16: 25960(T) (JPRS-13656(p.137-63))
trapping by cylindrical pinches, 16: 26421
wave attenuation in equilibrium isotropic, effects of electron beam interactions, 16: 25961(T) (JPRS-13656(p.164-76))
wave propagation in, analysis of thermal effects on dispersion relations, 16: 26398 (AD-270033)

PLASMA JETS
temperature of, determination of, by ultrasonic methods, 16: 26404 (RAD-TR-61-13)

PLASTIC COATINGS
protective effects of vinyl-, against corrosion of thorium and uranium during long-term storage, 16: 25713 (BMI-1563)

PLASTICS
decontamination by removal of iron-59 activity, evaluation of wetting agents for, 16: 25660(T) (JPRS-13691(p.8-12))
radiation effects on engineering properties, 16: 25843 (NARF-62-5T)
thermal radiation effects, 16: 25876(R) (AFSWP-844)

PLATES
magnetohydrodynamic flow past nonconducting flat, in transverse magnetic field, 16: 25913 (NP-11892)

PLATINUM
beta recoil of bismuth-212 and -214 from, 16: 26009
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
fabrication of powders into crucible susceptors, 16: 25704
neutron capture cross sections, 16: 26509
paramagnetism of ion impurities in, 16: 25999
properties, theory of infrared and optical, 16: 25758 (NP-11675)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351

PLATINUM CATALYSTS
effects on oxygen solubility in thorium oxide and water slurries, 16: 25324 (TID-16392)

PLATINUM FILMS
radiation effects on dislocations in, electron microscopic studies, 16: 25863

PLATINUM–RHODIUM ALLOYS
fabrication of powders into crucible susceptors, 16: 25704

PLUTONIUM
bibliography on methods and techniques for chemical analysis, 16: 25273 (UCRL-6873)
content in ground air, 1959, 16: 25171
cutaneous effects in swine, 16: 25122(R) (HW-72500(p.50-1))
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
dissolution by nitric and sulfamic acids, 16: 25310 (DP-737)
distribution in man and animals from fallout, 16: 25171
economic aspects of recycling for fuel, 16: 26467(R) (HW-73100)
fabrication and processing for fast ceramic reactors, economics, 16: 25697 (GEAP-3876)
preparation by reduction of trichloride using calcium and lanthanum at 700 to 850°C, 16: 25711(P)
properties as power reactor fuel, 16: 26609
radioinduced heating rate in, 16: 25802
removal of internally deposited, by chelating agents, 16: 25128(R) (HW-72500(p.77-80))
separation from irradiated fuel elements by solvent extraction, 16: 25473 (CEA-2123)
separation from uranium by solvent extraction with liquid metals, 16: 25474 (IS-470)
solvent extraction with triisooctylamine, 16: 25482(T) (AEC-tr-5197)
thermodynamic properties, 16: 25400

PLUTONIUM ALLOYS
bibliography on methods and techniques for chemical analysis, 16: 25273 (UCRL-6873)

PLUTONIUM CARBIDE–URANIUM CARBIDE SYSTEMS
preparation of monocarbide solid solutions by sintering at 1450 to 1850°C, 16: 25706

PLUTONIUM CARBIDES
preparation of mono- and sesquicarbides by sintering, 16: 25706
vapor pressure at 2000 to 2500°K, 16: 25385

PLUTONIUM(III) CHLORIDES
reduction to plutonium using calcium and lanthanum at 700 to 850°C, 16: 25711(P)

PLUTONIUM COMPLEXES
determination in solutions by solvent partition, 16: 25368

PLUTONIUM(VI) FLUORIDES
preparation, handling, and solvent properties for plutonium, 16: 25473 (CEA-2123)

PLUTONIUM HYDRIDES
hydrogen pressure of non-stoichiometric di-, equilibrium, 16: 25380

PLUTONIUM(IV) IONS
diffusion coefficients in Dowex 1-X4 and Permutit SK anion exchange resins, 16: 25309 (DP-727)
separation by liquid-liquid extraction, antagonistic and synergetic effects in, 16: 25480 (PAN-270/V)

PLUTONIUM(VI) IONS
separation by liquid-liquid extraction, antagonistic and synergetic effects in, 16: 25480 (PAN-270/V)

PLUTONIUM ISOTOPES
effects on performance of fast reactors, 16: 26549

PLUTONIUM ISOTOPES Pu-238
fission fragment measurements in strong backgrounds using nuclear emulsions, 16: 25558 (JINR-P-979)
PLUTONIUM ISOTOPES Pu-239
criticality studies, 16: 26533 (TID-13176)
determination by gamma counting, 16: 25473 (CEA-2123)
determination in man by gamma spectrography at 17 kev, 16: 25277(T) (AEC-tr-5251)
Doppler effect in fast reactors, 16: 26562
fission of, energy and time dependence of delayed gamma emission from, 16: 26222 (LAMS-2642)
neutron capture-to-fission cross section ratios at 30 to 1000 kev for, 16: 26510 (TID-12896)
neutron cross sections, least square analysis of 2200 m/sec, 16: 26216 (BNL-722)
neutron cross sections, 16: 26505 (TID-13546)
neutron fission to 15 Mev, prompt-neutron spectra from, 16: 26514
neutron reactions at 12 to 19 Mev, multiplication in, 16: 26241
pathological effects of inhaled, 16: 25126(R) (HW-72500(p.67-73))
retention, translocation, and excretion of inhaled, 16: 25125(R) (HW-72500(p.61-6))
toxic effects of injected, in miniature swine, 16: 25119(R) (HW-72500 (p.36-40))
transfer from plasma to milk, 16: 25121(R) (HW-72500(p.44-9))
PLUTONIUM ISOTOPES Pu-241
neutron fission cross section, 16: 26505 (TID-13546)
neutron fission cross sections at 0.03 to 1.8 Mev, 16: 26512
PLUTONIUM ISOTOPES Pu-242
fission fragment measurements in strong backgrounds using nuclear emulsions, 16: 25558 (JINR-P-979)
neutron fission cross section, 16: 26505 (TID-13546)
neutron fission cross sections at 0.03 to 1.8 Mev, 16: 26512
PLUTONIUM(IV) NITRATES
separation by liquid-liquid extraction, antagonistic and synergetic effects in, 16: 25480 (PAN-270/V)
PLUTONIUM (VI) NITRATES
separation by liquid-liquid extraction, antagonistic and synergetic effects in, 16: 25480 (PAN-270/V)
PLUTONIUM OXIDE--URANIUM OXIDE SYSTEMS
decladding and dissolution by the salt cycle process, 16: 26467(R) (HW-73100)
fabrication and processing for fast ceramic reactors, economics, 16: 25697 (GEAP-3876)
preparation and properties of powdered, 16: 25736(R) (NUMEC-P-100)
PLUTONIUM OXIDES
dispersion in glasses, 16: 26477 (TID-7622(p.74-85))
incorporation in glass for reactor fuel, 16: 26478 (TID-7622(p.86-97))
preparation and properties of powdered, 16: 25736(R) (NUMEC-P-100)
radioinduced fragmentation of particles in aqueous solutions, 16: 26493 (TID-7622(p.263-81))
thermodynamic properties, 16: 25400
volatile species, 16: 25381
PLUTONIUM RECYCLE TEST REACTOR
fuel fabrication and testing, 16: 26467(R) (HW-73100)
heavy water losses in, 16: 26616 (HW-73755)
instrumentation and operation, 16: 26467(R) (HW-73100)
pressure tubes, evaluation, 16: 26467(R) (HW-73100)
PLUTONIUM SULFATES
separation by liquid-liquid extraction, antagonistic and synergetic effects in, 16: 25480 (PAN-270/V)
PLUTONIUM--URANIUM ALLOYS
development for use as Phoenix fuels in compact reactors, 16: 26467(R) (HW-73100)
PLUTONIUM--WATER SYSTEMS
neutron buckling and cross sections for homogeneous, calculation of critical dimensions from, 16: 26463 (DP-701)
PNEUMATIC SYSTEMS
development in USSR, 16: 25567 (NP-11947)
POISONING
procedures for radiochemical facilities, 16: 25415 (ORNL-3309)
POLAND
fall-out monitoring in Cracow, Jan. through Mar. 1960, 16: 25620
POLYMERIZATION
mechanisms in radioinduced, 16: 25458
mechanisms in radioinduced, 16: 25457
POLYMERS
radiation modification and production of dielectric, 16: 25426
radioinduced production of graft, 16: 25871(P)
POLYPHENYLS
recovery of low molecular weight, from damaged reactor coolants, 16: 25263(P)
research program for studying, for reactor coolants, 16: 25312 (JEN-90-DQ/I-24)
POLYPHOSPHATES
properties, stability, and structure, 16: 25317(R) (NYO-9837)
POROSITY
measurement, development of apparatus using mercury penetration for, 16: 25787
PORPHYRIN COMPLEXES
hemato, effects combined with radiation on glycolysis in cancer tissue in man, 16: 25234
PORPHYRINS
hemato, effects combined with radiation on glycolysis in cancer tissue in man, 16: 25234
metabolism by *Hemophilus influenzae*, 16: 25153(R) (TID-16075)
POSITRONS
detection and measurement from 20 sources, development of scintillation counter for, 16: 25571 (TID-16268)
interactions with electrons, 16: 25906 (LNF-62/37(p.156-79))
interactions with electrons, lepton production and decay from, 16: 26185
storage rings for, 16: 25905 (LNF-62/37(p.161-5))
POTASSIUM
content in plants, 16: 25644 (CLOR-9)
corrosive effects on containment alloys and metals at high temperatures, review, 16: 25714 (DMIC-169)
determination in beryllium, flame photometric, 16: 25274 (Y-1394)
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
effects on solubility of uranium in bismuth, 16: 25815 (BNL-5156)
heat of adsorption on tungsten, 16: 26009
ion-core states in, effects of crystal field on, 16: 25884 (D1-82-0171)
isotopic composition in iron meteorites, 16: 25614 (JPL-TR-32-147)
separation by ion exchange on thallous phosphotungstate, 16: 25485
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
POTASSIUM BROMIDE CRYSTALS
ionic conductivity in plastically deformed, measurements of excess, 16: 25316 (NP-11921)
radioinduced luminescence, 16: 25914 (NP-11920)
POTASSIUM BROMORHENATES
neutron capture in, secondary reactions from, 16: 25449
POTASSIUM CHLORATES
annealing neutron-irradiated, thermal, 16: 25444
POTASSIUM CHLORIDE CRYSTALS
bleaching effects of x rays on F-band, comparison of, with effects of visible radiation, 16: 25838(R) (ARF-1184-5)
color-center paramagnetic relaxation in, at low temperatures, 16: 25985
ionic conductivity in plastically deformed, measurements of excess, 16: 25316 (NP-11921)
radioinduced luminescence, 16: 25914 (NP-11920)
thermal conductivity at 1 to 100°K of nitrite-ion-doped, 16: 25996
thermal effects on center widths in potassium-metal additively colored, 16: 25838(R) (ARF-1184-5)
POTASSIUM CHLORIDES
complex formation in aqueous solutions with thorium(IV) chlorides, methods of detection, 16: 25358
POTASSIUM FLUORIOBATES
preparation, properties, and structure of oxy-, 16: 25359
POTASSIUM IODATES
chlorine-38 oxidation states in neutron-irradiated, 16: 25443
POTASSIUM IONS
recoil, range from alpha reactions (α,n), 16: 26243
separation by ion exchange on thallous phosphotungstate, 16: 25485
POTASSIUM ISOTOPES
gamma dose rates from naturally occurring, in Japan, 16: 25675

POTASSIUM ISOTOPES K-39
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
POTASSIUM NITRATE CRYSTALS
radioinduced optical absorption in, 16: 25451
radiolysis, lattice compressibility relation to, 16: 25453
POTASSIUM NITRITES
potentials of nickel electrode in, 16: 25322 (TID-16292)
POTASSIUM PERCHLORATES
annealing neutron-irradiated, thermal, 16: 25444
chlorine-36 oxidation states in neutron irradiated, 16: 25443
POTASSIUM PERMANGANATES
analytical use for amperometric titration of nitrite ion at low concentrations, 16: 25272(R) (TID-16332)
POTASSIUM SILICATES
properties as strain gage cement at 1600°F, 16: 25560 (NAMC-ASL-1050 (Pt.III))
POTASSIUM-SODIUM ALLOYS
effects of hydrogen-containing, on niobium, 16: 25402
thermal conductivity of liquid, 16: 25535
POTASSIUM SULFATES
chlorine-34 oxidation states in proton-irradiated, 16: 25443
POWDERS
mixing velocity, effects of operation parameters, 16: 25512(T) (NP-tr-887)
POWER BREEDER REACTORS
fuel for, evaluation of plutonium, 16: 25697 (GEAP-3876)
POWER REACTORS
characteristics of fast, 16: 26551
coolant loss accident in, computer program for analysis, 16: 26588 (CVNA-117(Vol.II))
coolant research program for DON, 16: 25312 (JEN-90-DQ/I-24)
design concept using turbine-driven by uranium hexafluoride, 16: 26602(T) (AEC-tr-5164)
design of gas-cooled, heavy-water moderated, pressure-tube, 16: 26594 (GNEC-74)
economics of low-power graphite-moderated natural-uranium, 16: 26607
fuel element manufacture and testing by UKAEA for, 16: 26610
fuel for, development of plutonium, 16: 26609
materials for, properties of concrete, 16: 25781
meteorological aspects of location, 16: 25615 (NP-11760)
performance of large fast, effects of higher isotopes, recycling, and fission products on, 16: 26550
PRASEODYMIUM
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
PRASEODYMIUM IONS
distribution between aqueous acid solutions and resins, organic solvent effects on, 16: 25354
PRASEODYMIUM ISOTOPES Pr-141
energy level strength fractions for, 16: 26518
gamma mixing ratio, 16: 26242
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
PRASEODYMIUM ISOTOPES Pr-144
transfer from plasma to milk, 16: 25121(R) (HW-72500(p.44-9))
PRASEODYMIUM OXIDES
oxidation and reduction of, kinetics, 16: 25323(R) (TID-16350)
oxidation and stoichiometry, basic study, 16: 25315 (NP-11758)
thermodynamic properties, 16: 25386
PRECIPITATION
analysis for nitric oxide-ions, Zugspitzplatt (2580 m NN) August 15 to September 21, 1955, 16: 25625
PRESSURE
equipment and techniques for ultra-high, survey, 16: 25515(T) (NP-tr-892)
PRESSURE DROP
in eccentric annuli, 16: 25526 (NYO-9649)
in forced convective flow of steam-water mixtures in vertical heated and unheated annuli, 16: 25519 (AERE-R-3808)
in steam-water systems in round tubes, 16: 25530(T) (EURAEC-42)
PRESSURE VESSELS
design and construction of large gas cooled reactors, 16: 26497 (TID-16138)
fatigue cycling and stress analysis, 16: 25607
PROMETHIUM
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
PROMETHIUM ISOTOPES Pm-147
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
PROMPT NEUTRONS
angular distributions and velocities from californium-252 fission, 16: 26320 (UCRL-9713(Rev.))
attenuation by concrete, 16: 25415 (ORNL-3309)
PROPANE
radiolysis in presence of radical scavengers at 0.35 to 6000 mm and 40 to 220°C, 16: 25434
1,3-PROPANEDIONE, 1,3-BIS(m-BROMOPHENYL)-
crystal structure, 16: 25262 (IS-295)
2-PROPANOL
radiolysis mechanism, 16: 25419(R) (RRL-84)
solvent effects on praseodymium ion exchange between aqueous acid solutions and resins, 16: 25354
PROPENE, 2-METHYL-
radioinduced polymerization and copolymerization to styrene in ethylchloride, gamma, 16: 25457
PROPENE, 2-METHYL- POLYMERS
radioinduced crosslinking, effects of polyfunctional monomers on, 16: 25418(R) (RAI-306)
PROPENE POLYMERS
radiation effects on dynamic properties, 16: 25853(R) (TID-16273)
radioinduced crosslinking, effects of polyfunctional monomers on, 16: 25418(R) (RAI-306)
PROPENEDIOL
protective effects against whole-body radiation in mice, 16: 25252 (TID-16160)
PROPORTIONAL DETECTORS
design of helium-3, for fast neutrons, 16: 26204(T) (AEC-tr-5217)
PROPULSION
ion and plasma systems for, materials problems in, 16: 26633
nuclear, Soviet control and instrumentation developments for, 16: 25567 (NP-11947)
PROTACTINIUM ISOTOPES Pa-233
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
PROTEINS
hydrogen isotope exchange studies, 16: 25332
PROTON CROSS SECTIONS
nuclear-matter granulation effects on, at 3 to 25 Bev, 16: 26274
PROTONS
charge distribution, 16: 25877(R) (ANL-6534)
detection of recoil, from mesons (π^0) photoproduction, 16: 25936 (NP-11977(p.102-4))
distributions from $_{\Lambda}He^5$ decay, 16: 26363
energy of recoil, from mesons (π^0) photoproduction, 16: 25937 (NP-11977(p.107-8))
form factors, analysis of complex values in time-like region, 16: 26112
injection into synchrocyclotrons, 16: 26371 (JINR-P-930)
interaction with mesons (π) at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions at 24 Bev, cross-section relation to Pomeranchuk-trajectory slope, 16: 26122
interactions at 5.2 Mev, differential cross sections for elastic, 16: 26179
interactions with photons, differential cross section for, 16: 25890 (LNF-62/37(p.28-34))
interactions with photons at high energies, production of mesons (η) in, 16: 25897 (LNF-62/37(p.89-98))
interactions with mesons (π^-) at 170 Mev, cross sections for charge-exchange, 16: 25924 (NP-11977(p.55-7))
interactions with mesons (π^-) at 7 to 8 Bev, 16: 26068 (JINR-D-965)
interactions with mesons (K) at 1 Bev, elastic, 16: 26071 (JINR-P-817)
interactions with neutrons, angular distributions of mesons (π^0) produced in, 16: 26082 (JINR-P-981)
interactions with mesons (π^-) and (π^+) at 310 Mev, phase shifts and scattering cross sections for, 16: 26093 (UCRL-10252)
interactions with mesons (π) at 290 to 1500 Mev, 16: 26104

interactions with neutrons at 350 Mev, meson (π)-nucleon coupling constant from, 16: 26105
interactions with mesons (π^-), effects of meson (ρ) resonances, 16: 26114
interactions with mesons (π^+) at 820, 900, and 1050 Mev, angular distributions and cross sections for, 16: 26120
interactions with antiprotons at rest, neutral-particle production and quantum numbers from, 16: 26121
interactions with mesons (π^-) at 16 Bev, cross-section relation to Pomeranchuk-trajectory slope, 16: 26122
interactions with mesons (π^-) to 1.9 Bev, dispersion relations for, 16: 26123
interactions with mesons (π^-) at 20.7 and 31.0 Mev, charge-exchange cross sections for, 16: 26127 (NYO-9545)
interactions with mesons (π^-) at 2.1 Bev/c, kinematics, 16: 26134
interactions with neutrons at 128 Mev, triple-scattering parameters, 16: 26140
interactions with mesons (K^-), hyperon (Σ^+) production in, 16: 26143
interactions with mesons (π^-) at 1.89 and 2.10 Bev/c, meson (K) production cross sections for, 16: 26146
interactions with mesons (ρ) below 1 Bev, meson (ζ) even isotopic spin from, 16: 26152
interactions with mesons (π) and protons, high-energy, 16: 26159
interactions with antiprotons, ω-N coupling constant from, 16: 26175
interactions with mesons (π^-) at 7.2 Bev, differential cross sections for elastic, 16: 26180
interactions with antiprotons, meson production at 1.67 Bev, 16: 26233 (UCRL-10129)
interactions with neutrons near 30 Bev, inelastic cross sections, 16: 26252
momentum distributions in nuclear shells, 16: 26273
polarization of recoil, in mesons (π^0) photoproduction in region of primary resonance, 16: 25941 (NP-11977(p.120-1))
radiation effects at 95.5 Mev on solar cells, 16: 25845(R) (NP-11759)
reactions on nuclei at 3 to 25 Bev, cross sections, 16: 26274
reactions (p,α) with aluminum-27 at 9.7 to 14.5 Mev, angular distributions and cross sections for, 16: 26309
reactions (p,α) with magnesium-26 at 9.90 Mev, sodium-23 energy levels from, 16: 26310
reactions (p,γ) with chromium-50, -52, -53, and -54, 16: 26235
reactions (p,γ) with nuclei at (0.5 to 2.0) $\times 10^9$ °K at 10^{-5} to 10^5 gm cm^{-3}, rates of, 16: 26341
reactions (p,n) with nuclei, effects of isobaric spins on, 16: 26285
reactions (p,n) with nuclei at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
reactions (p,p' γ) with sulfur-32 at 5.7 to 6.34 Mev, angular correlations from, 16: 26327
reactions (p,pπ^+) with aluminum-27 at 130 to 660 Mev, 16: 26354
reactions with lead and bismuth at 120 to 660 Mev, production of astatine isotopes in, 16: 26220 (JINR-P-950)
reactions with nuclei at 0.66 and 9 Bev, fission charge spectra from, 16: 26329
scattering by carbon, calculation of reduced widths from, 16: 25877(R) (ANL-6534)
scattering by carbon-12 at 5.4 to 19.7 Mev, polarization effects, 16: 26263
scattering by copper at 6.6 Mev, inelastic, 16: 26349
scattering by oxygen-16 at 4.25 to 8.6 Mev, differential cross sections for elastic, 16: 26323
scattering by oxygen-16 at 4.25 to 8.6 Mev, differential cross sections for elastic, 16: 26324
scattering by sulfur-32 at 5.7 to 6.34 Mev, angular distributions from, 16: 26352
scattering of, by nickel-58 and titanium-48, polarization in inelastic, 16: 26226 (NYO-10131)
spectra from gamma reactions (γ,p) with lithium-7 at 12 to 16 Mev, 16: 26353

PSEUDOUREA, 2-(2-AMINOETHYL)-2-THIO-
protective effects against radiation damage in fetus after male exposure, 16: 25211
protective effects against radiation injuries to nucleic acid metabolism in mice, 16: 25255

PUERTO RICO POWER REACTOR
fuel assembly fabrication, 16: 25732 (GNEC-197)

PULSE ANALYZERS
design for automatic recording of pulse height distribution, 16: 25583
pulse-height resolution by, effects of noise, 16: 25554 (HASL-118)

PULSE GENERATORS (ELECTRONICS)
design for generation of Poisson time-distributed random pulses, 16: 25555 (IDO-16783)

PULSE INTEGRATORS
design and properties of linear, for isotope research, 16: 25591

PUMPS
design of renewable liquid gettering type, 16: 25603(P)
operational efficiency of electric and steam driven reactor coolant, 16: 26584 (CEND-150(Pt.IV))

PYRUVIC ACID
radiation effects on oxidation in bacteria, protective effects of cysteine against, 16: 25223

Q

QUANTUM ELECTRODYNAMICS
formulation using Feynman integrals with gauge restrictions, 16: 25967
Lorentz-invariant formulation in terms of electromagnetic field strengths, 16: 26433 (JINR-E-975)
spectral functions for one-electron propagator in, fourth-order, 16: 26100
wave equations for many-electron systems, 16: 26003

QUANTUM MECHANICS
adiabatic invariance in, conditions for approximate validity of, 16: 26448
book: *The Theory of Fundamental Processes*, 16: 26453
energy levels of N-particle systems in, 16: 26441
equation of state for many-body systems having square-well potentials, 16: 26168
field and particle aspects, mathematical analysis, 16: 26087 (NP-11780)
precision of Bogolyubov method in theory of even-even nonspherical nuclei, 16: 26218 (JINR-P-923)
S-matrix calculation for one-dimensional Schrödinger equation and asymptotic behavior, 16: 26435 (JINR-P-906)
theory of measurements using ergodicity conditions, 16: 26439
theory of quadrupole radiation, 16: 26234(T) (NP-tr-885)

QUARTZ
analysis for iron and uranium, activation, 16: 25281
phase studies, 16: 25547 (AROD-2302.8)

QUINOLINES
analytical uses, polarography, and preparation, 16: 25272(R) (TID-16332)

R

RABBITS
bismuth sulfide retention in organs, intravenously injected colloidal, 16: 25104
histological effects of injections of hemolytic substance from irradiated liver, on, 16: 25227
phosphorus-32 excretion in liver bile in, 16: 25156
phosphorus-32 injection effects on blood cells in bone marrow and lymph in, 16: 25202
radiation effects of radium on cornea and sclera in eyes of, 16: 25185
radiation effects of radium on optic nerve, retina, and uvea in eyes of, 16: 25186
radiation effects of radium on lens in eyes of, 16: 25187
radiation effects on hematopoietic system in, 16: 25205
radiation effects on unsaturation variations in serum lipids in, 16: 25229
radiation effects on nervous system, prenatal exposure, 16: 25242
radiation effects on nervous system, prenatal exposure, 16: 25243
radiation effects on adrenaline sensitivity and nervous system in, prenatal exposure, 16: 25244
radiation effects on brain of, prenatal exposure, 16: 25247
radiation injuries in, protective effects of orotic acid against, 16: 25257
thorium dioxide uptake by liver and spleen in, colloidal, 16: 25162
uranium deposition in blood and organs in, 16: 25158

RADIATION

biological effects of whole-body exposure of rats, 16: 25175 (TID-16051)
biological effects, protection against, 16: 25254
book: *Effects of Ionizing Radiation on Functions of Central Nervous System*, 16: 25235
book: *Effects of Ionizing Radiation on the Function of Higher Central Nervous System in Progenies*, 16: 25236
chemical effects on Brazilian peppermint oil, 16: 25450
detection and measurement of high-energy, design of photographic film plate, 16: 25574(T,P) (AEC-tr-5193)
detection and measurement in environment, 16: 25170(R) (TID-16123)
dosimetry with films, 16: 25658(T) (AERE-Trans-895)
effects of embryonic exposure on adult life expectancy and pathology in mice, 16: 25177(R) (TID-16129)
effects on cornea and sclera of eyes in rabbit, 16: 25185
effects on development in marine organisms, 16: 25175 (TID-16051)
effects on electroencephalographic pattern of prenatally irradiated rabbits, 16: 25243
effects on gestation and progenies in white rats, 16: 25238
effects on glycolysis in cancer tissue in man, combined with hematoporphyrin, 16: 25234
effects on growth of wheat, synergistic effects of chemical mutagens, 16: 25194 (CNEN-124)
effects on hematopoietic system in dogs and rabbits, 16: 25205
effects on hemic cells, *in vivo* and *in vitro*, 16: 25191
effects on lens in eyes in rabbits, 16: 25187
effects on mouse population genetics, gonad exposure, 16: 25182(R) (TID-16323)
effects on nervous system of adult animals, prenatal exposure, 16: 25237
effects on nervous system of rabbits, prenatal exposure, 16: 25242
effects on nervous system of rats, embryo exposure, 16: 25245
effects on nervous system of rats, chronic embryo exposure, 16: 25241
effects on optic nerve, retina, and uvea in eyes in rabbit, 16: 25186
effects on peripheral blood of prenatally exposed rats, 16: 25248
effects on response to bone marrow transplantation, 16: 25109
effects on synthesis of biologically active amines, 16: 25178(R) (TID-16113)
effects on synthesis of biologically active amines, 16: 25250(R) (NP-11753)
genetic effects in Drosophila, doubling dose for, 16: 25210
pathological effects on nervous system of rats, prenatal exposure, 16: 25246

RADIATION CHEMISTRY
of dielectric polymers, 16: 25426
recoil atom reaction mechanisms, 16: 25449

RADIATION DETECTION INSTRUMENTS
calibration for mesons (π^0) photoproduction experiments, 16: 25892 (LNF-62/37(p.46-56))
calibration for mesons (π^0) photoproduction experiments, 16: 25893 (LNF-62/37(p.57-71))
design and performance for measuring ultraviolet, visible, and infrared radiation, 16: 25595
design for hyperons (Λ^0) polarization measurements, 16: 25895 (LNF-62/37(p.76-80))
development in USSR, 16: 25567 (NP-11947)
performance in various arrangements for parity conservation measurement, 16: 25944 (NP-11977(p.127-9))
performance of portable radiac, 16: 25572 (USNRDL-TR-567)

RADIATION DETECTION INSTRUMENTS (ION CURRENT TYPE)
performance for scanning of liver, 16: 25098
performance for scanning liver, 16: 25099

RADIATION DETECTION INSTRUMENTS (PULSE TYPE)
design for low activities, 16: 25584
design of Geiger-Mueller, for tritium determinations, 16: 25592

RADIATION DETECTORS
description of superconducting-film-type, 16: 25590

RADIATION EFFECTS
bibliography of REIC accession, 16: 25844 (NP-11656)
bibliography on, on semiconductor devices, 16: 25842 (LAMS-2706)
conference on nuclear reactor chemistry, Gatlinburg, Tenn., October 10 to 12, 1961, 16: 26472 (TID-7622)
on properties of piezoelectric resonators, 16: 25857

RADIATION INJURIES
effects on lipid metabolism in liver, 16: 25178(R) (TID-16131)
from long-term ingestion of strontium-90, in miniature swine, 16: 25112(R) (HW-72500(p.1-12))
protection against, using cysteine, 16: 25129(R) (HW-72500(p.81-3))
protective effects of dry bone marrow injections against, in guinea pigs, 16: 25204
protective effects of sulfhydryl compounds, reaction mechanisms, 16: 25251(R) (TID-16159)
protective effects of chemical agents against, in mice, 16: 25253
protective effects of AET and MEA against, to nucleic acid metabolism in mice, 16: 25255
protective effects of adrenochrome against, during radiotherapy of post-operative breast tumors, 16: 25256
protective effects of orotic acid against, in rabbits, 16: 25257
reaction mechanisms, role of copper component of cytochrome c oxidase, 16: 25174 (TID-11988)
treatment in man, 16: 25184(T) (SCL-T-424)

RADIATION PROTECTION
bibliography, 16: 25476 (ORNL-2971(Vol.4))
code for display of radiation sources at exhibitions, 16: 25679
dosimetric control and safety procedures in handling uranium, 16: 25678
fission product permissible limits for, 16: 25643 (CEA-2163)
insurance in field of, review, 16: 25666
integrated dose measurement by mechanographic methods, 16: 25550 (CEA-2128)
of cells, role of copper component of cytochrome c oxidase, 16: 25174 (TID-11988)

RADIATION SICKNESS
therapy with Marzine, 16: 25259

RADIATION SOURCES
display at exhibitions, safety code, 16: 25679
industrial uses, radiation protection of personnel, 16: 25680
intensity of rapidly decaying, estimation of, 16: 25548 (AROD-2763:9)

RADIATION TARGET CANS
design for studies of radiation-induced swelling of uranium, 16: 25840 (HW-65453)

RADICALS
electron spin resonance of transient, hydrocarbon, 16: 25419(R) (RRL-84)
photoionization, 16: 26027

RADIO TUNING CIRCUITS
testing, radiation effects of electromagnetic fields on personnel for, 16: 25662(T) (JPRS-13691(p.20-4))

RADIOACTIVE MATERIALS
calcination of residues, process development, 16: 26467(R) (HW-73100)
container design, IAEA safety requirements, 16: 25672
detection in liver by scintillation scanning, 16: 25098
detection in liver by scintillation scanning, 16: 25099
separation from water, survey of filter processes for, 16: 25677
shipping, methods of fighting fires in accidents during, 16: 25669
shipping regulations, review of national and international, 16: 25671

RADIOACTIVITY
detection and measurements in sewage and water, 16: 25677
dose rates from natural gamma-emitting sources in Japan, 16: 25675
measurement of residual, design of system for, 16: 25910(R) (NP-11760)
meteorological factors in reactor location selection, 16: 25615 (NP-11760)
monitoring at Paducah Plant, 1961, 16: 25653 (KY-419)

RADIOAUTOGRAPHY
application in localization of zinc-65 in tissue samples, 16: 25133(R) (HW-72500(p.97-101))
use of Kodak AR.10 stripping film, 16: 25508 (TID-16158)

RADIOBIOLOGY
research activities at Hanford, 1961, 16: 25111(R) (HW-72500)

RADIOCHEMICAL PROCESSING PLANTS
criticality control by soluble poisons, 16: 25415 (ORNL-3309)

RADIOCHEMISTRY
development in Japan, 16: 25084 (JAERI-7020)
micro-coulometric analysis in, 16: 25285

RADIOGRAPHY
bibliography on gamma, 16: 25604 (BNL-716)

industrial, radiation protection of personnel, 16: 25680
RADIOISOTOPES
accountability system, 16: 25663
determination in urine, bibliography on, 16: 25268 (JAERI-4020)
distribution of natural gamma-emitting, in Japan, 16: 25675
handling and shipping in United Kingdom, 16: 25673
handling, hygienic and safety standards for shipping centers and storehouses, 16: 25661(T) (JPRS-13691(p.13-19))
use in automatic control apparatus, 16: 25683
RADIOLOGICAL TELEMETERING SYSTEMS
design of high-speed tape recording system for visualization of information from scintiscans, 16: 25098
design of high-speed tape recording system for visualization of information from scintiscans, 16: 25099
RADIOSENSITIVITY
effects of ploidy in leeches, 16: 25198 (CNEN-117)
of rat embryos, 16: 25231
of reproductive cells in rainbow trout, 16: 25213
reaction mechanisms, role of copper component of cytochrome c oxidase, 16: 25174 (TID-11988)
RADIOSTERILIZATION
bibliography on, of food, 16: 25685 (SB-403(Rev.))
of foods, bibliography on packaging requirements for, 16: 25681 (TID-15144)
of foods, effects on survival of spores of *Clostridium botulinum*, 16: 25172(R) (NP-11726)
RADIOTHERAPY
of breast cancer, fibroatelectasis in postoperative, 16: 25165
of breast cancer, lung tolerance dose in, 16: 25160
of cancer, effects on plasmin activity, 16: 25161
of malignant tumors, effects of leopon on anemia induced during, 16: 25159
of non-malignant diseases of neck and pharynx, cancer induction by, 16: 25201
production and properties of electron beams, 16: 25188
RADIUM
concentration in Israel water sources, 16: 25624
histological effects on cornea and sclera in eyes in rabbit, 16: 25185
histological effects on optic nerve, retina, and uvea in eyes in rabbit, 16: 25186
histological effects on lens in eyes in rabbits, 16: 25187
RADIUM ISOTOPES
gamma dose rates from naturally occurring, in Japan, 16: 25675
RADIUM ISOTOPES Ra-226
toxic effects of injected, in miniature swine, 16: 25119(R) (HW-72500 (p.36-40))
RADON
concentration in Israel water sources, 16: 25624
RAIN WATER
analysis for radioactivity, samples collected in northern Europe, 1961 and 1962, 16: 25167(R) (NP-11884)
analysis for tritium, in northern Europe, 1957 to 1962, 16: 25619(R) (TID-16272)
fall-out monitoring, Canada, Jan.–March 1962, 16: 25616(R) (NP-11914)
RARE EARTH ALLOYS
thermodynamic properties of bismuth, 16: 25391
RARE EARTH COMPLEXES
properties of ethylenediamine tetraacetic acid, 16: 25337 (IS-297)
RARE EARTH COMPOUNDS
preparation with general formula $A_2B_2O_7$ incorporating trivalent cations, 16: 25342
RARE EARTH OXIDES
phase studies and structural relations in, 16: 25323(R) (TID-16350)
thermodynamic properties, 16: 25388
RARE EARTH TELLURIDES
polishing, evaluation of chemicals for, 16: 25738
RARE EARTHS
crystal structure, magnetic energy effects on, 16: 25801
distribution in meteorites, 16: 25648(R) (GA-2782(Rev.))
magnetic spin-lattice relaxation times, temperature effects, 16: 25995
separation of actinides from lanthanides by solvent extraction, 16: 25495(P)
RARE GASES
ionization processes in, between parallel-plate electrodes, 16: 26008
purification for nuclear technology uses, 16: 25517
RATE METERS
image fading in photographic film, latent, 16: 25645 (CLOR-11)
performance for monitoring air, 16: 25542 (AEEW-R-150)
performance of Soap Bowl, for beta field dosimetry, 16: 25650 (HW-52448)
properties of film, 16: 25658(T) (AERE-Trans-895)
use of sanitation practice, 16: 25665
RATS
copper metabolism, effects of molybdate, 16: 25151(R) (TID-16073)
radiation effects, 16: 25175 (TID-16051)
radiation effects on mast cells in skin, ultrasoft x, 16: 25206
radiation effects on Yoshida ascites sarcomas in, 16: 25220
radiation effects on blood pressure in, whole-body, 16: 25222
radiation effects on progenies, 16: 25238
radiation effects on nervous system of, prenatal exposure, 16: 25239
radiation effects on nervous system of, antenatal exposure, 16: 25240
radiation effects on nervous system of, prenatal exposure, 16: 25241
radiation effects on nervous system of, prenatal exposure, 16: 25245
radiation effects on nervous system of, prenatal exposure, 16: 25246
radiation effects on blood picture in, prenatal exposure, 16: 25248
radiosensitivity of embryos, 16: 25231
uptake and distribution of tritium in, 16: 25110 (CEA-2155)
REACTION MECHANISMS
rates of, relation to concentrations, kinematic factors, and temperature, 16: 26045
REACTOR CONTROL RODS
design of rotatable cylinders containing neutron absorbers and reflectors, 16: 26578(P)
drives for, survey of electric, 16: 26499
kinetic effects on power, methods of estimating, 16: 26468 (IDO-16777)
manipulation, design of cable and helical conduit in reactor wall for, 16: 26575(P)
performance of bare and nickel-plated cadmium-indium-silver, 16: 25796
shock absorber design, 16: 26572(P)
REACTOR CONTROL SYSTEMS
design of automatic, computer program for use in, 16: 26454 (AEEW-R-156)
design of cruciform control rod joint, 16: 26574(P)
design using contiguous cylinders filled with neutron-absorbing and neutron-reflecting materials, 16: 26576(P)
REACTOR COOLANTS
monitoring, Cherenkov detector, 16: 25596(P)
monitoring, Cherenkov detector, 16: 25597(P)
monitoring for fission products, Cherenkov detector, 16: 25598(P)
organic, research program for studying, 16: 25312 (JEN-90-DQ/I-24)
recovery of polyphenyls from damaged, 16: 25263(P)
sampling valve, 16: 26462 (DP-658)
REACTOR COOLING SYSTEMS
pump efficiency, comparison of electric and steam driven, 16: 26584 (CEND-150(Pt.IV))
REACTOR ENGINEERING
book: *Thermal Power Engineering for Nuclear Installations*, 16: 26605(T) (FTD-TT-61-241)
developments at Knolls Atomic Power Lab., 16: 26470 (KAPL-2000-18)
fuel element and cask temperatures in fuel removal with loss of coolant flow, 16: 26471 (NAA-SR-Memo-4738)
properties of plutonium for use in near-thermal reactors, 16: 25736(R) (NUMEC-P-100)
sodium flow controller permanent magnet coupling, 16: 25569 (TID-15915)
Tmarc retaining ring failure mechanisms, 16: 26612 (HW-73643)
REACTOR FUEL ELEMENTS
bond structure in aluminum bonded to nickel-plated uranium, 16: 25817
cleaning organic moderated, ultrasonic, 16: 25700(R) (NYO-10282)
core support structure for, 16: 26579(P)
decladding and dissolution by the salt cycle process, 16: 26467(R) (HW-73100)
design of concentric tubular assembly for organic moderated reactors, 16: 26571(P)
design of fuel-breeder type, 16: 26580(P)
design of rod assembly for gas-cooled reactors, 16: 26573(P)

development for heavy water reactors, 16: 25735(R) (NMI-7251)
fission gas release from defective sheathed, method of calculation, 16: 26485 (TID-7622(p.160-70))
fission-product release from claddings, 16: 25750(R) (BMI-X-196)
loading and unloading of, transfer machine analysis of, 16: 26465 (GAMD-1318)
manufacture and testing by UKAEA for power reactors, 16: 26610
power simulation by induction heating in concentric, uniform, 16: 25605 (DC-55-11-47)
shipping of spent, design and economic studies, 16: 25647(R) (EURAEC-164)
temperature of spent during removal from reactor with loss of coolant flow, 16: 26471 (NAA-SR-Memo-6938)

REACTOR FUEL ELEMENTS (CERAMIC)
characteristics of fast systems of, 16: 26552
development of uranium oxide and monocarbide in France, 16: 25703(T) (AEC-tr-5216)
fabrication, 16: 25736(R) (NUMEC-P-100)
fabrication and radiation effects on PRTR uranium oxide, 16: 26467(R) (HW-73100)
fabrication of plutonium oxide-uranium oxide systems for, economics, 16: 25697 (GEAP-3876)
fission product recoil loss from, 16: 26487 (TID-7622(p.193-206))
fission product release on in-pile melting, 16: 26488 (TID-7622(p.207-15))
fission products, activity in Mol from, 16: 26498(T) (AEC-tr-5212)
properties at high temperatures, 16: 25745 (AECL-1529)
swaging of plutonium enriched, 16: 26467(R) (HW-73100)

REACTOR FUEL RODS
fabrication, 16: 25085 (JAERI-7022)
thermal cycling effects on uranium, 16: 25766(T) (AEC-tr-5076)

REACTOR FUEL SPHERES
fabrication, 16: 25736(R) (NUMEC-P-100)

REACTOR FUELS
analysis, 16: 25085 (JAERI-7022)
bibliography on processing and waste disposal, 16: 25476 (ORNL-2971 (Vol.4))
critical measurements on metallic and ceramic, in fast critical systems, 16: 26524
development at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
development of molten plutonium-iron alloy contained in tantalum vessel for, 16: 26577(P)
fission product retention behavior, 16: 26486 (TID-7622(p.171-92))
incorporation in glasses, 16: 26477 (TID-7622(p.74-85))
management for boiling reactors, program evaluation for EURATOM, 16: 26464(R) (EURAEC-255)
preparation of ceramic-coated particles, 16: 26476 (TID-7622(p.57-73))
preparation of plutonium-bearing glass, 16: 26478 (TID-7622(p.86-97))
processing, 16: 25085 (JAERI-7022)
processing, accountability measurement procedures for, 16: 25479 (ORNL-TM-288)
processing developments, review, 16: 25493
processing, poisoning procedures for, 16: 25415 (ORNL-3309)

REACTOR MATERIALS
conference on nuclear reactor chemistry, Gatlinburg, Tenn., October 10 to 12, 1961, 16: 26472 (TID-7622)
development at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
development review, 16: 25709
radioinduced heating by thermal neutron reactions, 16: 26231 (TRG-Report-322)
welding, development of gas shielded-arc methods for, 16: 25740

REACTOR MATRICES
neutron spectra as function of position in, computer program for calculation, 16: 26459 (BNL-5826)
properties of graphite, 16: 26063 (CEA-2157)

REACTOR MODERATORS
neutron diffusion and thermalization in finite, 16: 26206
neutron spectrum measurements in, extraction hole effects on thermal, 16: 26199 (NP-11932)

REACTOR SAFETY
Doppler effect relation to, in fast oxide reactors, 16: 26561
major accident analyses for experimental zero-power fast reactor assemblies, 16: 26565
nuclear aspects of, in fast reactors, 16: 26563

REACTOR SAFETY EXPERIMENTS
melt-down studies in transient reactor tests, 16: 26564
reactivity of SPERT-III, 16: 26456 (APAE-MEMO-279)

REACTORS
critical dimensions of slab and spherical, theoretical study, 16: 26064 (RM-2917-PR)
critical mass calculations, sensitivity to changes in neutron scattering data, 16: 26541
critical size and reactivity calculations, validity of the transport approximation, 16: 26539
design concepts for advanced, 16: 26467(R) (HW-73100)
development in Japan, 16: 25084 (JAERI-7020)
exponential experiment design for, 16: 26469 (JEN-89-DF/I-28)
gamma and neutron production and escape in, computer code for, 16: 26466 (GEMP-123)
heat transfer, 16: 25085 (JAERI-7022)
kinetics, 16: 25085 (JAERI-7022)
kinetics, autocorrelation of reactivity fluctuations, 16: 26501
neutron flux distribution gage for, 16: 25562 (NP-11705)
neutron flux distribution calculations by individual source-sink method for systems of finite height, 16: 26500
power reduction in, method of estimating kinetic effects of scram rods, 16: 26468 (IDO-16777)
reactivity coefficient calculation by perturbation theory, 16: 26543
reactivity of central air gap in bare, 16: 26540
tabulation of U. S., 16: 26496 (TID-8200(6th Rev.))

RECOIL IONS
range distributions from alpha reactions (α,n), 16: 26243
reaction mechanisms in solids, 16: 25449

REFRACTORY COATINGS
endurance of aluminum phosphate-bonded mixtures containing silicon dioxide, 16: 25761(R) (PWA-2088)

REFRACTORY MATERIALS
bibliography, 16: 25768(T) (NASA-TT-F-102)
book: *Analysis of Hard High-Melting Alloys*, 16: 25835
fabrication into crucible susceptors, 16: 25704

RELATIVITY THEORY
covariant quantum fields in, formulations using stochastic observers, 16: 26444
electron wave equations in gravitational fields, 16: 25991
invariant spatial distance in curved, spherically symmetric space-time, 16: 26011
invariant spatial distance in curved space-time, 16: 26016
operators of proper homogeneous Lorentz group in, 16: 25966

REMOTE-CONTROL EQUIPMENT
for fuel handling, radial arm indexing mechanism analysis, 16: 26465 (GAMD-1318)
radioisotopes in, 16: 25683

RESEARCH REACTORS
characteristics, 16: 26621
design and operation of Russian fast pulsed, 16: 26570
development at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
development in Japan, 16: 25085 (JAERI-7022)
ecological conditions in area of Ispra 1, 16: 25166 (CNI-54)
experimental facilities of Avogadro RSI, 16: 26625
hazards analysis for Babcock and Wilcox Test Reactor, 16: 26458 (BAW-183)
kinetics of, study by probability method, 16: 26557
operation procedures in France, 16: 26624
performance and research programs of Astra, 16: 26623

RESINS
abrasive tests on ion exchange, 16: 25497 (ACCO-66)
adsorptive properties for uranium, 16: 25465 (ACCO-26)
radiation effects on dynamic properties of epoxy, 16: 25853(R) (TID-16273)

RHENIUM
alloying effects on ductile-to-brittle transition in refractory metals, 16: 25751 (DMIC-Memo-155)

RHENIUM FLUORIDES
magnetic susceptibility at 4 to 296°K, 16: 25347

RHODIUM
neutron capture cross sections, 16: 26509
paramagnetism of iron impurities in, 16: 25999
RHODIUM COMPOUNDS
radiolysis of aqueous solutions, 16: 25430
RHODIUM ISOTOPES Rh-97
beta decay, mass discrepancies from, 16: 26287 (IS-408)
RHODIUM ISOTOPES Rh-99
beta decay, mass discrepancies from, 16: 26287 (IS-408)
RHODIUM ISOTOPES Rh-101
beta decay, mass discrepancies from, 16: 26287 (IS-408)
RHODIUM ISOTOPES Rh-103
energy level strength functions for, 16: 26518
gamma reactions (γ,n) to 23 Mev, neutron yields from, 16: 26357
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
RIBONUCLEIC ACID
radiation effects on content in chick embryo, gamma and x, 16: 25207
radiation effects on, in liver and spleen, 16: 25208
RIBONUCLEIC ACID, DESOXY-
content in transplanted Yoshida sarcomas, effects of fatty acid extracts from irradiated rabbits on, 16: 25228
molecular reactions in transforming, 16: 25152(R) (TID-16075)
radiation effect on sedimentation coefficients of, from *E. coli*, 16: 25218
radiation effects on content in chick embryo, gamma and x, 16: 25207
radiation effects on, in liver and spleen, 16: 25208
radiation effects on, in bacteria, 16: 25223
RIBOSE
radiolysis of dilute aqueous solutions in presence of oxygen, 16: 25440
ROCKET MOTOR NOZZLES
fabrication of pyrolytic graphite components for, 16: 25728 (AD-270153)
ROCKET MOTORS
materials, data on insulation, nozzle, and throat, 16: 25744(R) (AD-269196)
ROCKET REACTORS
temperature sensor development for, 16: 26630 (NP-11861)
ROCKET REACTORS (KIWI)
radiation hazards analysis, 16: 25655 (TID-14960)
ROCKET REACTORS (TORY)
design and neutronic calculations for II-A, 16: 26632 (UCRL-6304)
ROCKETS
cryogenic engineering in nuclear, 16: 25516
ROCKS
hafnium–zirconium ratio in, 16: 25631
thorium and uranium content in New Hampshire, geologic mapping, 16: 25618(R) (TID-15225)
ROOTS
radioinduced chromosome breakage in interphase meristems, 16: 25217
RUBBER
radiation effects on resilience and hardness of oil-extended, 16: 25873(P)
radioinduced degradation of butyl, gamma, 16: 25869
RUBIDIUM
corrosion protection, tests of capsules for, 16: 25712(R) (AGN-8051)
corrosive effects on containment alloys and metals at high temperatures, review, 16: 25714 (DMIC-169)
metabolism by plants, effects of chloramphenicol on uptake by roots, 16: 25139(R) (HW-72500(p.123-7))
separation by ion exchange on thallous phosphotungstate, 16: 25485
RUBIDIUM IONS
separation by ion exchange on thallous phosphotungstate, 16: 25485
RUBIDIUM ISOTOPES Rb-85
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
RUBIDIUM ISOTOPES Rb-87
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
RUBIDIUM ISOTOPES Rb-89
determination in fission gases, spectrometric, 16: 25295
RUBIDIUM NITRATES
radiolysis, lattice compressibility relation to, 16: 25453
RUSSIAN REACTORS
neutron spectra in BR-5, 16: 26204(T) (AEC-tr-5217)
RUTHENIUM
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
oxidation states and polarographic potentials, 16: 25343
solvent extraction with triisooctylamine, 16: 25482(T) (AEC-tr-5197)
RUTHENIUM ISOTOPES Ru-95
production in technetium-95 decay, mass discrepancies from, 16: 26287 (IS-408)
RUTHENIUM ISOTOPES Ru-97
production in technetium-97 decay, mass discrepancies from, 16: 26287 (IS-408)
RUTHENIUM OXIDES
absorption by silica gel, capacity data, 16: 26467(R) (HW-73100)

S

SABUGALITES
crystal properties, 16: 25638
SACLAY REACTORS
design of RAPSODIE, 16: 26569
SACLAY REACTORS (EL-2)
design and performance of, 16: 26626
SACLAY REACTORS (EL-3)
auxiliaries, design of cryogenic device for production of cold neutron beam, 16: 26193 (CEA-2012)
design and performance of, 16: 26626
SAFETY
personnel-exposure and contamination control at the ORNL Research Reactor, 16: 25654 (ORNL-TM-278)
regulations for radioactive material containers, IAEA, 16: 25672
regulations for radioisotope handling and shipping in United Kingdom, 16: 25673
regulations in radioactive material shipping, review, 16: 25671
SAFETY HAZARDS
in fuel element shipping, 16: 25647(R) (EURAEC-164)
in use of uranium in commercial alloys, 16: 25664
SAMARIUM
determination in uranium, spectrographic and spectrophotometric, 16: 25266 (CNEN-135)
determination in yttrium and samarium oxides, activation, 16: 25292
neutron capture cross sections, 16: 26509
poisoning efficiency in radiochemical processes, 16: 25415 (ORNL-3309)
properties as phosphor activator, 16: 25974
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
SAMARIUM COMPLEXES
with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, syathesis, 16: 25321(R) (TID-16224)
SAMARIUM ISOTOPES Sm-147
neutron capture cross sections at 10^3 to 10^6 ev, 16: 26518
SAMARIUM ISOTOPES Sm-149
poisoning efficiency in radiochemical processes, 16: 25415 (ORNL-3309)
SAMARIUM OXIDES
analysis, neutron activation, 16: 25292
thermodynamic properties, 16: 25386
SANDS
drift movement on Thyborn Inlet, Denmark, tracer study, 16: 25641
SANITARY ENGINEERING
radiation dosimeters for, 16: 25665
SARCOMAS
immunogenic effects of irradiated Sarcoma I ascites tumor on mice, 16: 25108
radiation effects on Yoshida ascites, in rats, 16: 25220
radiation effects on development, growth, and sensitivity of Yoshida ascites, 16: 25221
succinic dehydrogenase activity in Yoshida, effects of fatty acid extracts from irradiated rabbits on, 16: 25225
transplanted Yoshida, effects of fatty acid extracts from irradiated rabbits on DNA and mitosis in, 16: 25228
SATELLITES
flight of Discoverer XVIII, radiobiological experiments, 16: 25173 (NP-11784)
SCALERS
design of transistorized microsecond, 16: 25563 (NP-11735)

SCANDIUM
determination in silicate rocks, combined cation exchange-spectrochemical, 16: 25287
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
vapor pressure, measurements using tracers, 16: 25778
SCANDIUM COMPLEXES
equilibrium quotients and stability of bromide and chloride, 16: 25356
SCANDIUM–TITANIUM ALLOYS
phase studies, 16: 25824 (IS-310)
SCATTERING
amplitudes above the Bev region, "multicenter" peripheral model for, 16: 26116
amplitudes at high energies and fixed angles, asymptotic, 16: 26446
amplitudes, perturbation expansion integral representation for, 16: 26437
amplitudes, Regge-pole application effects on, 16: 26128
analysis of high-energy diffraction, using Regge poles, 16: 26154
behavior of cross sections at high energies, 16: 26447
data analysis, 16: 26071 (JINR-P-817)
derivation of impulse approximation, 16: 26441
linear equations for, 16: 26085 (NP-11632)
matrix construction without divergences, 16: 26181
partial-wave amplitudes from N/D method, 16: 26132
potential, effects of kinetic properties of scatterers, 16: 26440
unitary symmetry effects on strong interactions, 16: 26156
SCINTILLATION DETECTORS
applications in estimations of liver size after administration of radioactive materials, 16: 25100
design and operation of automatic and semi-automatic, 16: 25940 (NP-11977(p.116-20))
design for tumor localization and organ visualization after administration of radioisotopes, 16: 25097(R) (TID-16081)
development for counting simultaneously positrons emitted from 20 sources, 16: 25571 (TID-16268)
development of boron-containing and lithium-containing glass, 16: 25877(R) (ANL-6534)
performance for monitoring air, 16: 25542 (AEEW-R-150)
performance for scanning liver for radioactive materials, 16: 25098
performance for scanning liver for radioactive materials, 16: 25099
performance in detection of iodine-131 rose bengal and colloidal gold-198 in liver, 16: 25190
performance in localization of brain tumors after administration of arsenic-74, 16: 25102
SCREENS
efficiency for water entrainment removal by, method of predicting, 16: 26470 (KAPL-2000-18)
SCRUBBERS
for removal of radioiodine, 16: 26636(R) (EURAEC-84)
SEA WATER
analysis for tritium, in northern Europe, 1957 to 1962, 16: 25619(R) (TID-16272)
SEALS AND GLANDS
potential of visco seal for use on compressors and turbines of gas cooled reactors, 16: 25506 (TID-15987)
survey on design of labyrinth, 16: 25505 (TID-15986)
survey on theory of interface conditions in mechanical, 16: 25507 (TID-15988)
SEED
effects of x radiation combined with chemical mutagens on tobacco, 16: 25193 (CNEN-118)
genetic effects of irradiation in tomato, 16: 25197 (CNEN-119)
SEIGNETTOELECTRIC MATERIALS
radiation effects on hysteresis loop of guanidinium aluminum sulfate crystals, 16: 25456
SEISMIC WAVES
coupling in spherical underground cavities, 16: 25633 (UCRL-6086(Rev.))
coupling to media, shotpoint effects on, 16: 25632 (UCRL-6059)
SEISMOLOGY
bibliography on Soviet, 16: 25608 (AD-265437)
SELENIUM
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
SELENIUM ISOTOPES
proton reactions (p,n) at 17 Mev on even, effects of excited isobaric states, 16: 26333 (UCRL-6830)
SELENIUM ISOTOPES Se-76
deuteron elastic scattering and stripping reactions (d,p) at 7.8 Mev, cross sections for, 16: 26300
SELENIUM ISOTOPES Se-77
electron conversion coefficients and neutron activation cross sections for metastable, 16: 26351
half life, 16: 26213 (AE-78)
neutron capture cross sections at 10^3 to 10^4 ev, 16: 26518
proton elastic scattering at 13 Mev, cross sections for, 16: 26300
SELENIUM ISOTOPES Se-79
electron conversion coefficients and neutron activation cross sections for metastable, 16: 26351
SEMICONDUCTOR DETECTORS
design and performance as nuclear spectrometers, 16: 25585
development in USSR, 16: 25567 (NP-11947)
development of miniature silicon carbide, for alpha particles, 16: 25573(R) (WCAP-1989)
measurement of energy and line width of 6.8- to 18-Mev monochromatic neutron beams with silicon, 16: 25589
SEMICONDUCTORS
bibliography on radiation effects on, 16: 25842 (LAMS-2706)
crystal structure, 16: 25547 (AROD-2302.8)
SEPARATION PROCESSES
development at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
SEWAGE
decontamination, 16: 25677
SF MATERIALS ACCOUNTING
procedures for, in fuel processing, 16: 25479 (ORNL-TM-288)
SHELLS
heat transfer from internally heated thin, convective and radiative, 16: 25536
SHELTERS
blast effects on family defense, experimental, 16: 25657 (WT-359)
SHIELDED CONTAINERS
design and testing, for radioactive material shipping, 16: 25672
design for waste disposal, 16: 26641 (TID-15431)
legal requirements for, for shipping radioactive materials, 16: 25671
SHIELDING
neutron flux distributions in, development of hand calculations for, 16: 26432 (APEX-652)
SHIPPING
container safety regulations for radioactive materials, IAEA, 16: 25672
facilities for radioisotope, in United Kingdom, 16: 25673
of radioactive materials, review of national and international regulations, 16: 25671
SHIPPINGPORT PRESSURIZED WATER REACTOR
control rods testing for evaluation of radiation effects on hafnium in, 16: 25854 (WAPD-TM-336)
coolant radioactivity in Seed 1, 16: 26599 (WAPD-PWR-TE-79)
data logging and computing system calibration tests, 16: 26591 (DLCS-4000301(Rev.))
plant container air cooling system testing, 16: 26590 (DLCS-3960101)
SHOCK TUBES
design and performance for atomic property measurements, 16: 26029
plasma acceleration in magnetic annular, 16: 25912 (NP-11848)
SHOCK WAVES
propagation at remote distances from explosion point, 16: 25639
propagation in magnetic annular shock tube, 16: 25912 (NP-11848)
SILANES
polymerization and copolymerization of allylhydro-, catalytic, and radio-induced, 16: 25459
SILICATE ROCKS
analysis for cerium, lanthanum, neodymium, scandium, and yttrium, 16: 25287
SILICATES
decontamination by removal of iron-59 activity, evaluation of wetting agents for, 16: 25660(T) (JPRS-13691(p.8-12))
SILICIDES

preparation, properties, and uses of refractory metal, 16: 25768(T) (NASA-TT-F-102)
properties of high-melting, 16: 25835
SILICON
determination in gallium arsenides by neutron activation, 16: 25293
determination in niobium and its alloys, 16: 25294
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
effects on corrosion resistance of molybdenum, niobium, tungsten, 16: 25721(T) (FTD-TT-61-31(p.60-9))
neutron capture cross sections, 16: 26509
neutron scattering at 3.4 to 4.6 Mev, angular distributions, 16: 26507
SILICON CARBIDES
development for neutron detectors, 16: 25573(R) (WCAP-1989)
SILICON CRYSTALS
corrosion, volume effect by, 16: 25722(T) (UCRL-Trans-830)
radiation effects on infrared absorption bands in, fast neutron, 16: 25866
SILICON ISOTOPES Si-28
deuteron reactions (d,p) at 15 Mev, effects of spin-orbit distortion, 16: 26284
deuteron reactions (d,α) at 5.5 to 7.5 Mev, angular distributions and cross sections for, 16: 26309
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
neutron reactions (n,α) at 6.8 to 18 Mev, spectra from, 16: 25589
neutron reactions (n,p) and (n,α) at high energies, spectra from, 16: 26306
neutron reactions (n,α) and (n,d) at 14 Mev, spectra from, 16: 26297
SILICON ISOTOPES Si-29
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
neutron reactions (n,α) at 14 Mev, spectra from, 16: 26297
neutron reactions (n,p) and (n,α) at high energies, spectra from, 16: 26306
SILICON JUNCTIONS
use as high-speed switches, 16: 25581 (UCRL-6012-T(Rev.1))
SILICON NITRIDES
preparation and properties for use at 1200°C, 16: 25795
SILICON OXIDE COATINGS
endurance on space power systems, 16: 25761(R) (PWA-2088)
SILICON OXIDES (COLLOIDAL)
properties as desiccant for purifying carbon dioxide, 16: 25299 (AAEC/E-86)
properties as strain gage cement at 1600°F, 16: 25560 (NAMC-ASL-1050 (Pt.III))
SILICON OXIDES (FUSED)
radiation effects on slip-cast, fast neutron, 16: 25856
SILICON–URANIUM SYSTEMS
fabrication and properties, 16: 25735(R) (NMI-7251)
SILICONE RUBBERS
radiation effects on engineering properties, 16: 25843 (NARF-62-5T)
radiovulcanization, advantages of, 16: 25684
SILVER
adsorptive properties for cadmium and mercury, 16: 26009
deformation, stored energy increase and release after, 16: 25821
fracture under impulsive loading, 16: 25759 (NP-11890)
neutron capture cross sections, 16: 26509
properties, theory of infrared and optical, 16: 25758 (NP-11675)
proton fission at 9 Bev, charge spectra from, 16: 26329
separation by ion exchange on thallous phosphotungstate, 16: 25485
solvent properties for plutonium, 16: 25474 (IS-470)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
SILVER (COLLOIDAL)
production by photon irradiation of silver bromides, 16: 25867
SILVER BROMIDES
radiation effects, photon, 16: 25867
SILVER CHLORIDE CRYSTALS
charged particle tracks in large, delineation of, 16: 25546 (AFOSR-3030)
SILVER DEUTERIDES
emission spectrum at 3100 to 3900 Å for silver-107 and -109 labeled, 16: 25331
SILVER FILMS
optical emission of irradiated, 16: 25847 (ORNL-3114)
SILVER HYDRIDES
emission spectrum, 16: 25331
SILVER IONS
separation by ion exchange on thallous phosphotungstate, 16: 25485
SILVER ISOTOPES Ag-105
decay schemes, electron K-capture, 16: 26295
SILVER ISOTOPES Ag-107
energy level strength functions for, 16: 26518
energy levels and gamma spectra, 16: 26280
gamma reactions (γ,n) to 23 Mev, neutron yields from, 16: 26357
SILVER ISOTOPES Ag-108
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
SILVER ISOTOPES Ag-109
energy level strength functions for, 16: 26518
SILVER ISOTOPES Ag-110
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
half life, 16: 26213 (AE-78)
SINTERING
theory of solid-state, 16: 25698 (NP-11636)
SIOUX FALLS POWER REACTOR
testing, program and organization for preoperational and initial startup, 16: 26582 (ACNP-6112)
SKELETON
growth and development of beagle, effects of continuous ingestion of strontium-90, 16: 25153(R) (UCD-106)
SKIN
effects of injected plutonium, in swine, 16: 25122(R) (HW-72500 (p.50-1))
phosphorus-32 uptake by subcutaneous, 16: 25164
radiation effects on mast cells in rats, ultrasoft x, 16: 25206
SODIUM
corrosive effects on containment alloys and metals at high temperatures, review, 16: 25714 (DMIC-169)
determination in beryllium, flame photometric, 16: 25274 (Y-1394)
effects on solubility of uranium in bismuth, 16: 25815 (BNL-5156)
flow, permanent magnet coupling for controller, 16: 25569 (TID-15915)
heat of adsorption on tungsten, 16: 26009
ion-core states in, effects of crystal field on, 16: 25884 (D1-82-0171)
physical effects on mechanical strength of steels, 16: 25720(T) (FTD-TT-61-31(p.41-59))
reactions of vaporous, with glasses, pyrolytic graphite, and refractories at 940°C, 16: 25318 (RAD-TM-60-44)
reactivity coefficients in large fast reactors, 16: 26545
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
wetting cobalt, iron, and nickel by liquid, effects of barium and calcium additions to liquid and of oxide films, 16: 25782
SODIUM CARBONATES
analysis for carbon dioxides, microdiffusion, 16: 25291
SODIUM CHLORATES
annealing neutron-irradiated, thermal, 16: 25444
chlorine-34, -36, and -38 oxidation states in irradiated, 16: 25443
SODIUM CHLORIDE CRYSTALS
ionic conductivity in plastically deformed, measurements of excess, 16: 25316 (NP-11921)
neutron double Bragg scattering by single, angular distributions, 16: 26211
radioinduced luminescence, 16: 25914 (NP-11920)
SODIUM CHLORIDES
adsorptive properties for aluminum, 16: 26009
chlorine-36 oxidation states in neutron irradiated, 16: 25443
complex formation in aqueous solutions with thorium(IV) chlorides, methods of detection, 16: 25358
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
SODIUM CHLORITES
annealing neutron-irradiated, thermal, 16: 25444
SODIUM ISOTOPES Na-23
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
energy levels from proton reactions (p,α) with magnesium-26 at 9.90 Mev,

16: 26310
neutron inelastic scattering cross sections to 3.97 Mev by, 16: 26508
neutron reactions (n,α) at 14 Mev, angular and energy distributions from, 16: 26245
SODIUM ISOTOPES Na-24
energy levels and gamma spectra, 16: 26254
SODIUM NITRATE CRYSTALS
radiolysis, lattice compressibility relation, 16: 25453
SODIUM NITRATES
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
potentials of nickel electrode in, 16: 25322 (TID-16292)
SODIUM PERCHLORATES
annealing neutron-irradiated, thermal, 16: 25444
chlorine-38 oxidation states in neutron-irradiated, 16: 25443
SODIUM PHOSPHATES
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
SODIUM REACTOR EXPERIMENT
control rod calibrations for thorium-uranium fuel, 16: 26597 (NAA-SR-6585)
core-2 flow and power ramp stability tests on, 16: 26223 (NAA-SR-7250)
SODIUM SULFATES
chlorine-34 oxidation states in proton-irradiated, 16: 25443
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
SODIUM SULFIDES
corrosive effects on high-strength alloys and steels under static stress, 16: 25717(R) (NP-11948)
SODIUM URANIUM(IV) FLUORIDES
fluorination, preparation of trisodium uranium(V) fluoride by, 16: 25328(T) (AEC-tr-5205)
SODIUM URANIUM (V) FLUORIDES
preparation and structure, 16: 25328(T) (AEC-tr-5205)
SOILS
ecology of desert, 16: 25148(R) (HW-72500(p.161-4))
fission product migration in, 16: 26636(R) (EURAEC-84)
mineral cycling in mesophytic forest, tracer study, 16: 25150(R) (TID-15963)
sorptive properties of humus for uranium(IV) and (VI), 16: 25364
SOLAR BATTERIES
design and characteristics, 16: 25080 (ASD-TR-61-11(Vol.I))
SOLAR FLARES
chromospheric striation obscured by, 16: 26046 (AFCRL-834)
frequency, duration, energy, and calculations of radiation dose, 16: 26631 (RM-2825-PR)
SOLAR RADIATION
solar wind effects on diurnal cosmic-ray variations, 16: 26059
SOLIDS
analysis, use of Rutherford scattering in, 16: 25682(R) (TID-16013)
beta recoil from surfaces of, 16: 26009
electrons in, self-consistent field theory for, 16: 26015
physical properties, sonic study, 16: 25547 (AROD-2302.8)
representations of systems of dipoles and ions, classical theory, 16: 26019
SOLUTIONS
analysis for complex compounds by partition method, 16: 25368
SOLVENT EXTRACTION PROCESSES
development, 16: 25085 (JAERI-7022)
SOLVENT PARTITION
analysis of complex compounds in solutions by, 16: 25368
SOVIET UNION
geology of granitic rocks, 16: 25627
SPACE
cosmic radiation intensity variations in, 16: 26053
electrostatic potentials of metallic spheres in interplanetary, 16: 26050
environment, effects on vehicles and crew in vicinity of earth-moon system, 16: 26627 (ASD-TR-61-201)
SPACE FLIGHT
environmental hazards in vicinity of earth-moon system, 16: 26627 (ASD-TR-61-201)
reentry simulation, design concepts for ARGMA 8000-kw plasma facility for, 16: 25499 (ARGMA-TN-2HSN)
SPACE VEHICLES
design, effects of space environment, 16: 26627 (ASD-TR-61-201)
design of nuclear for planetary landing missions, 16: 26628 (JPL-TR-32-231)
electrostatic potential of spherical metallic, in interplanetary space, 16: 26050
instrumentation design requirements, 16: 25588
power supplies for, 16: 26598 (NAA-SR-7144)
power systems, parametric study of electric, 16: 26629(R) (NP-11728)
shielding, 16: 26631 (RM-2825-PR)
SPALLATION
research program at Naples, 16: 25900 (LNF-62/37(p.115-17))
SPANISH REACTORS (JEN-1)
design and performance, 16: 26617 (JEN-97-DF/I-30)
SPARK DETECTORS
design and performance of plane-parallel, 16: 25575(T) (AEC-tr-5239)
development in USSR, 16: 25567 (NP-11947)
SPECTROPHOTOMETRY
book: *Atomic-Absorption Spectrophotometry*, 16: 25297
SPECTROSCOPY
review of Hungarian research in, 16: 25091
SPERM
radiosensitivity in Drosophila, effects of developmental stage, 16: 25192
SPERMATOGENESIS
radiosensitivity in Drosophila, 16: 25192
radiosensitivity in rainbow trout, 16: 25213
SPHERES
electrostatic potential of metallic, in interplanetary space, 16: 26050
SPLEEN
diseases, diagnosis with aid of contrast radiography and radioisotope scanning, 16: 25101
radiation effects on DNA and RNA in, gamma and x, 16: 25208
radiation effects on nucleic acid metabolism in mouse, gamma and x, 16: 25212
radiation effects on nucleic acid metabolism in mouse, protective effects of AET and MEA against, 16: 25255
thorium dioxide uptake in rabbit, colloidal, 16: 25162
SPONTANEOUS FISSION
fragment excitation energies and threshold in, 16: 26361
SPRINGS
radiation effects on creep of graphite, 16: 25870
STACK DISPOSAL
removal of radioiodine, 16: 26636(R) (EURAEC-84)
STAINLESS STEEL
decontamination by removal of iron-59 activity, evaluation of wetting agents for, 16: 25660(T) (JPRS-13691(p.8-12))
gamma resonance absorption in type 310, 16: 26225 (NP-11913)
heat transfer and pressure drop in eccentric tubes, 16: 25526 (NYO-9649)
magnetic susceptibility of type 18-8, 16: 25882 (ASD-TR-61-630)
STAINLESS STEEL (FERRITIC)
diffusion in, effects of crystal deformation on, 16: 25831
STAINLESS STEEL COMPACTS
properties as reactor core material, 16: 25762 (SCNC-264)
STAINLESS STEEL–URANIUM(IV) OXIDE COMPACTS
mechanical properties as reactor core material, 16: 25762 (SCNC-264)
STARS
particle configurations from supernovae, relativistic, 16: 26048
STATISTICS
distribution functions in classical fluids, approximations of pair, 16: 26445
kinetics of matter, effects on scattering parameters, 16: 26440
STEAM
corrosive effects at 1000 to 1300°F on niobium-base alloys, additive optimization, 16: 25695(R) (BMI-X-188)
quality estimation in pipes by x ray scattering, 16: 25551 (CRRP-1086)
STEAM ENGINEERING
book: *Thermal Power Engineering for Nuclear Installations*, 16: 26605(T) (FTD-TT-61-241)
STEAM–WATER SYSTEMS
heat transfer in round tubes, 16: 25530(T) (EURAEC-42)

heat transfer properties, 16: 26603(T,R) (EURAEC-36)
heat transfer properties, 16: 26604(T,R) (EURAEC-38)
pressure drop in vertical heated and unheated annuli for forced convective flow, 16: 25519 (AERE-R-3808)
separation of water entrainment from, efficiency of screens for, 16: 26470 (KAPL-2000-18)
STEEL
corrosion, effects of surface saturation with aluminum or chromium, 16: 25721(T) (FTD-TT-61-31(p.60-9))
fracture under impulsive loading, 16: 25759 (NP-11890)
properties of low-alloy, for pressure vessels, 16: 26497 (TID-16138)
radiation effects on heat strength of low-carbon, 16: 25859
strength, effects of sodium, 16: 25720(T) (FTD-TT-61-31(p.41-59))
stress-corrosion cracking of high-strength, in synthetic environment, 16: 25717(R) (NP-11948)
thermal cycling, 16: 25085 (JAERI-7022)
STERILITY
radiation effects on, in workers in Japan, 16: 25214
STOMACH
iodine-131 deposition in, gonad exposure from, 16: 25618
STRAIN GAGES
cements for 1600°F, 16: 25560 (NAMC-ASL-1050(Pt.III))
development and testing of aluminum--chromium--iron, for use at 1600°F, 16: 25559 (NAMC-ASL-1050(Pt.II))
STRANGE PARTICLES
production in proton reactions with nuclei, 16: 26089 (NP-11832)
STRATOSPHERE
aerosol composition in, 16: 25609 (AFCRL-62-299)
STRESS ANALYSIS
of shells of revolution, computer program for, 16: 26470 (KAPL-2000-18)
STRONTIUM
coprecipitation with aragonite and calcite, 16: 25319 (TID-16128)
determination, micro-coulometric, 16: 25285
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
distribution in ores from Providencia, Mexico, 16: 25319 (TID-16128)
influx rate across trout gills, tracer study, 16: 25116(R) (HW-72500 (p.23-5))
neutron capture cross sections, 16: 26509
separation from condensate wastes containing ammonia by cation exchange, 16: 26638 (HW-71627)
separation from solutions by ion exchange, 16: 26467(R) (HW-73100)
STRONTIUM BORATES
luminescence of copper- and copper-lead-activated, 16: 25975
STRONTIUM ISOTOPES Sr-85
absorption by intestine in rats, 16: 25114(R) (HW-72500(p.15-18))
determination in blood serum ultrafiltrates, 16: 25115(R) (HW-72500 (p.19-22))
metabolism, effects of age, in miniature swine, 16: 25113(R) (HW-72500(p.13-14))
STRONTIUM ISOTOPES Sr-90
absorption by cultivated plants, 16: 25642 (CEA-2159)
absorption by sodium aluminosilicate, 16: 25651 (HW-71574)
biological effects of long-term feeding, in miniature swine, 16: 25112(R) (HW-72500(p.1-12))
containment and shipping, 16: 25651 (HW-71574)
content in milk from fall-out, Canada, Jan.–March 1962, 16: 25616(R) (NP-11914)
determination in bone samples collected in Great Britain, 1961, 16: 25168 (NP-11904)
distribution and retention in trout, 16: 25117(R) (HW-72500(p.26-9))
effects of continual ingestion during growth period of beagles, 16: 25153(R) (UCD-106)
toxic effects of injected, in miniature swine, 16: 25119(R) (HW-72500 (p.36-40))
use as beta source in coal processing, 16: 25414(R) (NYO-10184)
STRONTIUM ISOTOPES Sr-91
determination in fission gases, spectrometric, 16: 25295
STRONTIUM ISOTOPES Sr-92
determination in fission gases, spectrometric, 16: 25295
STRUCTURES
design of aluminum criticality assembly supporting, 16: 25705 (BNL-4932)
vibration, computer program for calculation, 16: 26470 (KAPL-2000-18)
STYRENE POLYMERS
electric conductivity during reactor irradiation, device for measurement, 16: 25582
electron spin resonance spectra in systems with tritium, 16: 25433
labeling with tritium, 16: 25433
radiation effects on dynamic properties, 16: 25853(R) (TID-16273)
radioinduced crosslinking, effects of polyfunctional monomers on, 16: 25418(R) (RAI-306)
STYRENES
radioinduced copolymerization to methyl methacrylate in ethylchloride, gamma, 16: 25458
radioinduced copolymerization to allylanilines, 16: 25459
radioinduced polymerization of p-N,N-dimethylamino-, 16: 25425
radioinduced polymerization and copolymerization to isobutene in ethylchloride, gamma, 16: 25457
SUBMARINE REACTORS
steamotor for, power control of double-acting, 16: 25539 (AD-269391)
SUCCINIC DEHYDROGENASE
activity in cancerous and normal mouse liver, effects of fatty acid extract from irradiated rabbits on, 16: 25224
activity in Yoshida sarcoma cells, effects of fatty acid extracts from irradiated rabbits on, 16: 25225
SULFAMIC ACID
solvent properties for plutonium, 16: 25310 (DP-737)
SULFATE IONS
equilibrium effects on anionic XX resin and uranyl sulfates, 16: 25330
SULFATES
determination in uranium trioxide and uranyl nitrate, gravimetric, 16: 25270 (PG-Report-330)
metabolism in bacteria, 16: 25151(R) (TID-16073)
separation from beryllium by solvent extraction using phosphate esters, 16: 25475 (NCL/AE-172)
SULFONIUM COMPOUNDS
protective effects against radiation injuries in mice, 16: 25253
SULFUR
chemical properties in lithium chloride-potassium chloride eutectic, 16: 25306 (CEA-2125)
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
neutron capture cross sections, 16: 26509
neutron scattering at 3.4 to 4.6 Mev, angular distributions, 16: 26507
sorption effects on ductile-to-brittle transition in alloyed and unalloyed refractory metals, 16: 25751 (DMIC-Memo-155)
SULFUR ISOTOPES S-32
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
proton reactions (p,p' γ) at 5.7 to 6.34 Mev, angular correlations from, 16: 26327
proton scattering at 5.7 to 6.34 Mev, angular distributions from, 16: 26352
SULFUR ISOTOPES S-34
energy level lifetimes, from resonance scattering of bremsstrahlung, 16: 26275
SULFURIC ACID
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
solvent properties for thorium dicarbide at room temperature and 80°C, 16: 25365
SUN
cosmic radiation intensity variations from, 16: 26053
SUPERCONDUCTIVITY
book: *Perturbation Theory and the Nuclear Many Body Problem*, 16: 26023
relation to electron reactions with crystal structure, 16: 25987
theory of, many-body Hamiltonian expectation value in quasi-chemical equilibrium, 16: 26012
SUPERCONDUCTORS
magnetic field reversal inside cylinders of, 16: 25997
magnetic-flux quantization in, 16: 25982
performance of films as radiation detectors, 16: 25590
properties and uses, survey, 16: 25881 (ASD-TN-61-160)
SUPERHEATERS

materials for sodium, 16: 25502 (NAA-SR-Memo-6849)
SUPERHEATERS (NUCLEAR)
characteristics of coupled fast-thermal steam superheating system, 16: 26553
development of niobium-base alloys for use in, 16: 25695(R) (BMI-X-188)
SURFACE-ACTIVE AGENTS
coalescence effects at planar interfaces, 16: 25956 (UCRL-10097)
SURFACE ENERGY
relation to critical temperatures and surface tension, 16: 25351
SURFACE TENSION
relation to critical temperature and surface energy, 16: 25351
SURFACE WATERS
monitoring for radioactivity in creeks and Ohio River at Paducah Plant, 1961, 16: 25653 (KY-419)
SURFACES
beta recoil from solid, 16: 26009
SWIMMING POOL REACTORS
magnetic field device for irradiation studies in, 16: 26615 (CEA-2134)
water radiolysis in, formation and distribution of gases and hydrogen peroxide from, 16: 26496(T) (TID-7622(p.310-15))
SWINE
biological effects of long-term ingestion of strontium-90 in miniature, 16: 25112(R) (HW-72500(p.1-12))
effects of plutonium injected in skin, 16: 25122(R) (HW-72500(p.50-1))
metabolism of strontium-90 and calcium-45 in miniature, effects of age, 16: 25113(R) (HW-72500(p.13-14))
SWITCHES
development of high-speed transistor, 16: 25581 (UCRL-6012-T(Rev.1))
SYNCHROCYCLOTRONS
beam deflector for Buenos Aires 180-cm, design and performance of magnetic, 16: 26374 (NP-11889)
magnetic deflector system of Buenos Aires 180-cm, 16: 26373 (NP-11693)
particle injection into annular, 16: 26371 (JINR-P-930)
SYNCHROTRONS
beam extraction and properties of Frascati, review, 16: 25903 (LNF-62/37(p.142-56))
design and operational experiments at CERN proton, 16: 25917 (NP-11977(p.2-5))
design and testing, 16: 26376(T) (FTD-TT-61-242)
design of proton storage rings for CERN, 16: 25918 (NP-11977(p.5-20))
design of 10 Bev, 16: 25929 (NP-11977(p.78-80))
design of 15-Bev proton, 16: 25919 (NP-11977(p.20-31))
electron acceleration, capture theory, 16: 26384(T) (FTD-TT-61-242 (p.54-110))
electron bunch size on magnetic cycle of C-25 FIAN, 16: 26395
magnet pole face windings for German Electron Synchrotron (DESY), 16: 26370 (DESY-A1.9)
power supply for CERN 28-Bev proton, 16: 26392
SYNERGISTIC ACTION
of radiation and chemical mutagens on growth of wheat seedlings, 16: 25194 (CNEN-124)
of x radiation and chemical mutagens on tobacco seeds, 16: 25193 (CNEN-118)
of x radiation and actinomycin D in tissue cultures, 16: 25232
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-8)
radiator development, 16: 25761(R) (PWA-2088)
reflector fabrication for, 16: 25734 (NAA-SR-7293)

T

TANTALUM
coatings by anodic treatment and vapor deposition, 16: 25701 (WADD-TR-61-64)
conference on, University of Sheffield, Sept. 1960, 16: 25708
determination in titanium alloys, gravimetric, 16: 25269 (NP-11834)
dislocation-relaxation spectra of cold-worked, 16: 25807 (GA-1745)
fabrication of powders into crucible susceptors, 16: 25704
metallurgical effects on properties of aluminum–titanium-zirconium alloys, 16: 25813
neutron capture cross sections, 16: 26509
neutron scattering at 2 to 300 kev, 16: 25877(R) (ANL-6534)
nitrogen-14 and -15 reactions, neutron transfer in, 16: 26221 (JINR-P-973)
phase transition in alloyed and unalloyed, effects of interstitials on ductile-to-brittle, 16: 25751 (DMIC-Memo-155)
separation from niobium by solvent extraction with hydrofluoric acid–sulfuric acid–methyl isobutyl ketone, 16: 25492
thermal diffusivity at 1300 to 1600°C, 16: 25837(R) (AD-270841)
TANTALUM BORIDES
thermodynamic properties at 300 to 1200°K, 16: 25401
TANTALUM ISOTOPES Ta-180
decay, branching ratios for beta and electron capture, 16: 26255
TANTALUM ISOTOPES Ta-181
energy level strength functions for, 16: 26518
gamma reactions (γ,n) to 23 Mev, neutron yields from, 16: 26357
neutron reactions (n,α) at 14 Mev, cross sections and spectra from, 16: 26297
TANTALUM OXIDES
heat of formation, 16: 25334
TANTALUM–ZIRCONIUM ALLOYS
phase diagram, 16: 25823 (IS-320)
TECHNETIUM FLUORIDES
magnetic susceptibility, 16: 25347
TECHNETIUM ISOTOPES Tc-93
energy levels, excitation energies and spins for, 16: 26287 (IS-408)
TECHNETIUM ISOTOPES Tc-95
beta decay, mass discrepancies from, 16: 26287 (IS-408)
TECHNETIUM ISOTOPES Tc-97
beta decay, mass discrepancies from, 16: 26287 (IS-408)
TECHNETIUM ISOTOPES Tc-99
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
TELEVISION EQUIPMENT
design, for use with optical microscope for automatic scanning of blood cells, 16: 25568 (NYO-9644)
TELLURIUM
determination in meteorites, neutron activation, 16: 25623
determination in presence of bismuth, spectrophotometric, 16: 25267 (IA-724)
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
TELLURIUM IONS
chromatography of tetra- and hexavalent, rf values for, 16: 25265 (BLG/B-4)
TELLURIUM ISOTOPES Te-121
decay scheme and gamma spectra, 16: 26240
yield ratios for isomers produced in antimony-121 (d,2n) reaction, 16: 26240
TELLURIUM ISOTOPES Te-123
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
TELLURIUM ISOTOPES Te-125
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
TELLURIUM ISOTOPES Te-128
neutron reactions (n,α), (n,2n), (n,p), and (n,pα), production of antimony, tellurium, and tin isotopes in, 16: 25442
TELLURIUM ISOTOPES Te-130
neutron reactions (n,α) (n,2n), (n,p), and (n,pα), production of antimony, tellurium, and tin isotopes in, 16: 25442
TELLURIUM ISOTOPES Te-131
decay, iodine-131 bonding with toluene by, 16: 25417 (PAN-302/V)
TELLURIUM ISOTOPES Te-132
bibliography on, 1939 to 1961, 16: 25301 (BLG/B-1)
decay, iodine-132 bonding with toluene by, 16: 25417 (PAN-302/V)
TELLURIUM ISOTOPES Te-133
decay scheme, gamma spectra, and half life, 16: 26239
TELLURIUM ISOTOPES Te-134
gamma spectra and half life, 16: 26239
TELLURIUM OXIDES
separation of iodine-131 from irradiated, 16: 25488
TEMPERATURE
determination in plasma jets using ultrasonic methods, 16: 26404 (RAD-TR-61-13)

TEMPERATURE CONTROL
equipment development in USSR, 16: 25567 (NP-11947)
TENSILE PROPERTIES
measurements at 4.2 to 300°K, apparatus for, 16: 25769(T) (SCL-T-434)
TERBIUM
crystal structure, magnetic energy effects on, 16: 25801
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
TERBIUM ISOTOPES Tb-159
energy level strength functions for, 16: 26518
gamma reactions (γ,n) to 23 Mev, neutron yields from, 16: 26357
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
TERBIUM ISOTOPES Tb-160
beta emission from, dysprosium-160 production in, 16: 26346
gamma spectra below 1 Mev, 16: 26264
TERBIUM ISOTOPES Tb-161
preparation of carrier-free, using Dowex-50 resin, 16: 25445
TERBIUM OXIDES
magnetic susceptibility at 1 to 250°K, antiferromagnetic effects, 16: 25993
thermodynamic properties, 16: 25386
TEREPHTHALIC ACID, ETHYLENE POLYMER ESTERS
radiation effects on dynamic properties, 16: 25853(R) (TID-16273)
TERPHENYL
radioinduced fluorescence in *o*-xylene solution, effects of temperature on gamma, 16: 25413(R) (NP-11882)
THALLIUM
meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
neutron capture cross sections, 16: 26509
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
THALLIUM ISOTOPES
emission spectra, isotope shifts for A = 199 to 205, 16: 26331
THALLIUM ISOTOPES Tl-203
internal conversion of 279-kev gamma ray, L fluorescence yield from, 16: 26257
THALLIUM–URANIUM ALLOYS
thermodynamic properties at 450°C, 16: 25397
THERMAL CONDUCTIVITY
measurement at 2000 to 3800°F, design of apparatus for, 16: 25753 (GAMD-2089)
THERMAL NEUTRON CROSS SECTIONS
tables, 16: 26194 (JAERI-6010)
THERMAL NEUTRONS
capture of, by trimethylphosphine, effects on bonds of, 16: 25454 (BNL-4850)
capture resonance levels, Doppler broadening of, 16: 26214 (AERE-M-1035)
capture, two-group calculation of gamma radiation from, 16: 26202(T) (AEC-tr-5077)
polarization, 16: 26198 (NP-11859)
reactions (n,α) and (n,γ), heat transfer calculations for, 16: 26231 (TRG-Report-322)
scattering, Doppler approximations and models for, 16: 26209 (BNL-5821)
spectra as function of lattice position, computer program for calculation, 16: 26459 (BNL-5826)
spectra, extraction hole effects on, 16: 26199 (NP-11932)
THERMAL RADIATION
measurement, 16: 25595
simulation to atomic explosion, equipment for, 16: 25090
THERMAL RADIATION SOURCES
development of intense, 16: 25876(R) (AFSWP-844)
THERMAL REACTORS
characteristics of coupled fast-thermal steam superheating system, 16: 26553
effective lifetime and temperature coefficient in coupled fast-thermal systems, 16: 26556
safety studies at Argonne National Laboratory, 16: 26455(R) (ANL-6573)
THERMIONIC CELLS
current oscillations in systems containing cesium vapor, 16: 25957(T) (FTD-TT-63-637)
design and performance for compact nuclear power plants, 16: 26598 (NAA-SR-7144)
development of diode using film boiling liquid metal, 16: 26455(R) (ANL-6573)
efficiency and power output in parallel and series, 16: 25908 (NAA-SR-Memo-7278)
electric potential distributions in, 16: 25885 (GEST-2002)
energy transformation efficiency, 16: 25971
properties and prospective electric-power uses, review, 16: 25089
THERMOCOUPLES
design of cable to break under predetermined load, 16: 25599(P)
development for nuclear rocket reactors, 16: 26630 (NP-11861)
THERMODYNAMIC PROPERTIES
correlation of free energies and phase diagrams, 16: 25374
measurement of heats of formation with oxygen- and fluorine-bomb calorimetry, 16: 25396
measurement of heats of formation, 16: 25404
of actinide compounds, 16: 25398
of gases at high temperatures, calculation of, 16: 25875 (AFSWC-TDR-62-21)
of refractory borides at 300 to 1200°K, 16: 25401
THERMODYNAMICS
distribution functions in classical fluids, approximations of pair, 16: 26445
irreversible, 16: 25382
statistical, of fused salts, 16: 25390
THERMOELECTRIC CELLS
properties and prospective electric-power uses, review, 16: 25089
radiation effects on designs for solar use, 16: 25845(R) (NP-11759)
THERMONUCLEAR REACTORS
plasma heating and temperatures in, 16: 26409
properties and prospective electric-power uses, review, 16: 25089
THICKNESS GAGES
design of carbon-14, 16: 26108
memory in radiometric, factors affecting, 16: 25578
THIOLS
effects on metabolism in irradiated animals, 16: 25251(R) (TID-16159)
protective effects against radiation injuries, 16: 25251(R) (TID-16159)
THIOSULFATE IONS
reactions with benzyl chlorides, chlorine isotope effects in, 16: 25344
THORIUM
content in rocks in New Hampshire, geologic mapping, 16: 25618(R) (TID-15225)
corrosion during long-term storage, effects of coatings on, 16: 25713 (BMI-1563)
heat of adsorption on tungsten, 16: 26009
separation from fission products by solvent extraction, improvement of process for, 16: 25494(P)
thermodynamic properties, 16: 25400
work functions, 16: 25809 (AERE-R-3910)
THORIUM CARBIDE–URANIUM CARBIDE SYSTEMS
coating with carbon, apparatus for, 16: 25731 (GA-2241)
THORIUM CARBIDES
free energy of formation, 16: 25833
solubility of di-, in acids at room temperature and 80°C, 16: 25365
THORIUM(IV) CHLORIDES
complex formation in aqueous solutions with lithium, potassium, or sodium chlorides, methods of detection, 16: 25358
free energy of formation at 400 to 600°C, 16: 25392
THORIUM COMPLEXES
determination in solutions by solvent partition, 16: 25368
THORIUM DEPOSITS (SOVIET UNION)
geochemistry of granitic, 16: 25627
THORIUM IONS
solvent partition of tetravalent, in tributylphosphate systems, 16: 25489
THORIUM ISOTOPES
gamma dose rates from naturally occurring, in Japan, 16: 25675
THORIUM ISOTOPES Th-232
fission of, energy and time dependence of delayed gamma emission from, 16: 26222 (LAMS-2642)
neon-20 and -22 reactions, production of actinium-225 and -226 in,

16: 25411 (JINR-P-978)
neutron fission cross section, 16: 26505 (TID-13546)
neutron fission cross sections at 10^3 to 10^9 ev, 16: 26525
neutron scattering, fast, 16: 26505 (TID-13546)
photofission cross sections, 16: 25949 (NP-11977(p.144-6))
THORIUM NITRATES
solvent extraction by tributylphosphate, effects of diluents on, 16: 25489
THORIUM OXIDE POWDERS
radioinduced sintering, 16: 25848 (ORNL-3275)
THORIUM OXIDE SLURRIES
solvent properties for oxygen with and without platinum catalyst, 16: 25324 (TID-16392)
THORIUM OXIDE–URANIUM OXIDE SLURRIES
hydrogen–oxygen recombination in, effects of molybdenum oxide catalyst, 16: 25407(P)
radiation effects, 16: 26494 (TID-7622(p.282-99))
radioinduced fragmentation of particles in, 16: 26493 (TID-7622(p.263-81))
THORIUM OXIDES
dispersion in glasses, 16: 26477 (TID-7622(p.74-85))
thermodynamic properties, 16: 25400
THORIUM(IV) OXIDES
uptake of colloidal, by liver and spleen in rabbits, 16: 25162
vaporization rate in air, 16: 25403
THORIUM PHOSPHIDES
thermodynamic properties, 16: 25383
THORIUM, TETRACYCLOPENTADIENYL
preparation and properties, 16: 25370
THORIUM–ZIRCONIUM ALLOYS
analysis for zirconium, spectrophotometric, 16: 25284
THULIUM
crystal structure, magnetic energy effects on, 16: 25801
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
THULIUM ISOTOPES Tm-170
beta decay, polarization of conversion electrons, 16: 26086 (NP-11737)
THYMIDINE
metabolism in yeast, effects of cell division, tracer study, 16: 25136(R) (HW-72500(p.109-12))
THYMUS
radiation effects on nucleic acid metabolism in mouse, gamma and x, 16: 25212
radiation effects on nucleic acid metabolism in mouse, protective effects of AET and MEA against, 16: 25255
THYROID GLAND
function, effects on iodine-131 metabolism, 16: 25105
iodine uptake in newborn lambs, tracer study, 16: 25118(R) (HW-72500 (p.30-5))
TIMING CIRCUITS
design for measurement of mean life of π mesons, 16: 25948 (NP-11977(p.140-4))
development with ferrite core scales, 16: 25564 (NP-11822)
TIN
magnetic and thermal properties, thermodynamic consistencies between, 16: 25805
neutron capture cross sections, 16: 26509
properties, theory of infrared and optical, 16: 25758 (NP-11675)
superconducting cylinders of, transition temperature quantum periodicity in, 16: 25998
superconducting energy gap in, 16: 26010
superconducting films, performance as radiation detectors, 16: 25590
superconducting, magnetic field reversal inside cylinders of, 16: 25997
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
TIN HYDRIDES
neutron diffusion and thermalization in, 16: 26207
TIN ISOTOPES Sn-116
mass differences to tin-118 and -124, 16: 26335
TIN ISOTOPES Sn-117
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
mass difference to tin-119, 16: 26335
TIN ISOTOPES Sn-118
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
mass differences to tin-116 and -120, 16: 26335
TIN ISOTOPES Sn-119
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
mass difference to tin-117, 16: 26335
TIN ISOTOPES Sn-120
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
mass differences to tin-118 and -122, 16: 26335
TIN ISOTOPES Sn-121
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
TIN ISOTOPES Sn-122
mass differences to tin-120 and -124, 16: 26335
TIN ISOTOPES Sn-124
mass differences to tin-116 and -122, 16: 26335
TIN ISOTOPES Sn-125
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
TIN ISOTOPES Sn-127
radiochemical studies, 16: 25442
TIN ISOTOPES Sn-128
radiochemical studies, 16: 25442
TIN ISOTOPES Sn-129
radiochemical studies, 16: 25442
TIN ISOTOPES Sn-130
radiochemical studies, 16: 25442
TIN–URANIUM ALLOYS
thermodynamic properties at 450°C, 16: 25397
vapor pressure, 16: 25371
TIN–ZIRCONIUM ALLOYS
corrosion, 16: 25760 (ORNL-3281)
corrosion resistance of Zircaloy-2, effects of fabrication variables, 16: 25726
dissolution in anhydrous hydrogen fluoride–hydrogen chloride at 400 to 450°C, 16: 25710(P)
fatigue, effects of applied stress and hydrogen sorption on static, 16: 25746(R) (ARF-2230-9)
heat transfer between uranium dioxide and Zircaloy-2, coefficient of, 16: 25523 (CRFD-1075)
mechanical properties, 16: 25760 (ORNL-3281)
mechanical properties of unirradiated, 16: 26467(R) (HW-73100)
neutron diffusion and thermalization in hydrided, 16: 26207
oxidation in high temperature water, effects of hydrogen and oxygen, 16: 26467(R) (HW-73100)
radiation effects, 16: 25760 (ORNL-3281)
radiation effects, in reactor creep measurements, 16: 26467(R) (HW-73100)
thermodynamic properties of zirconium in, 16: 25406
TISSUE CULTURES
combined effects of x radiation and actinomycin D on cell growth in tissue cultures, 16: 25232
of blood cells, tracer studies, 16: 25191
TISSUES
phosphorus-32 distribution and excretion in, dose relation to, 16: 25163
therapy with ultrasonics, 16: 25219
transplantation, effects of irradiation and immune reactions on take, 16: 25096(R) (TID-15980)
TITANIUM
corrosion by lithium and lithium hydride, 16: 25718 (NP-11952)
determination in niobium and its alloys, 16: 25294
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
deuteron reactions (d,t) at 21.4 Mev, 16: 25877(R) (ANL-6534)
mesic atoms, mesons (μ^-) decay in, 16: 26080 (JINR-P-972)
meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
properties, theory of infrared and optical, 16: 25758 (NP-11675)
TITANIUM ALLOYS
analysis for hydrogen, niobium, oxygen, and tantalum, recommended methods, 16: 25269 (NP-11834)
TITANIUM BORIDES
thermodynamic properties at 300 to 1200°K, 16: 25401
TITANIUM CARBIDES
thermal capacity at 100 to 730°C, 16: 25837(R) (AD-270841)

TITANIUM FLUORIDES
heat of formation, measurement by combustion bomb calorimetry, 16: 25360
TITANIUM HYDRIDES
mesic atoms, mesons (μ^-) decay in, 16: 26080 (JINR-P-972)
TITANIUM ISOTOPES Ti-46
gamma decay of 2.004-Mev state, directional correlations in, 16: 26256
TITANIUM ISOTOPES Ti-48
deuteron elastic scattering, absorptive effects in, 16: 26342
deuteron reactions (d,n) at 4 Mev, neutron emission in, 16: 26306
proton inelastic scattering at 7 to 8 Mev, proton polarization from, 16: 26290
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
proton reactions (p,n) at 17 Mev, effects of excited isobaric states, 16: 26333 (UCRL-6830)
proton scattering by, polarization in inelastic, 16: 26226 (NYO-10131)
TITANIUM OXIDES
emissivity and endurance, 16: 25761(R) (PWA-2088)
TITANIUM–VANADIUM ALLOYS
specific heat in body-centered-cubic, at low temperatures, 16: 25806
TOBACCO
effects of x radiation combined with chemical mutagens on seeds, 16: 25193 (CNEN-118)
TOLUENE
bonding with iodine-131 or -132 atoms formed in tellurium decay, 16: 25417 (PAN-302/V)
diluent effects on extraction of europium and thorium nitrates by tributyl-phosphate, 16: 25489
heat transfer in boiling, electroconvection effects on, 16: 25533
photolysis in liquid butadiene, 16: 25419(R) (RRL-84)
radiation effects of beta particles and recoil carbon-14 in, 16: 25438
radiolysis of labeled and unlabeled, formation of hydrogen in, 16: 25412 (NAA-SR-6734)
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)
TOLUENE, α-CHLORO-
reactions with cyanides, thiosulfates, and water, chlorine isotope effects in, 16: 25344
TRACER TECHNIQUES (GEOLOGY)
pulse integrators for, design and properties of, 16: 25591
TRACER TECHNIQUES (MEDICINE)
development of radiation detection instrument, 16: 25097(R) (TID-16081)
TRANSDUCERS
design and operation of direct digital, 16: 25565 (NP-11860)
development of pneumatic, in USSR, 16: 25567 (NP-11947)
TRANSFORMATION TEMPERATURES
relation to surface energy and surface tension, 16: 25351
TRANSISTORS
radiation effects on field-effect-type, 16: 25860
TRANSITION METALS
dislocation-relaxation spectra cold-worked bcc, 16: 25807 (GA-1745)
magnetic spin-lattice relaxation times, temperature effects, 16: 25995
metallurgical effects on recrystallization temperature of nickel, 16: 25822
TRANSURANIC ELEMENTS
nuclear properties, studies based on superfluid model of nuclei, 16: 26217 (JINR-E-932)
TREES
mineral cycling in mesophytic forest, tracer study, 16: 25150(R) (TID-15963)
TRIBENZYLAMINE
solvent properties for iron in hydrochloric acid, effects of diluents on, 16: 25481 (PAN-303/V)
TRIBUTYLAMINE
solvent properties for iron in hydrochloric acid, effects of diluents on, 16: 25481 (PAN-303/V)
TRIISOÖCTYLAMINE
solvent properties for plutonium, ruthenium, uranium, and zirconium, 16: 25482(T) (AEC-tr-5197)
TRIOCTYLAMINE
solvent properties for plutonium(IV) and (VI), 16: 25480 (PAN-270/V)
solvent properties for iron in hydrochloric acid, effects of diluents on, 16: 25481 (PAN-303/V)
TRITIUM
conference on tracer applications, New York, October 31, 1958, 16: 25093
counting, light guides for liquid scintillation, 16: 25429
determination in atmospheric moisture, rain water, and sea water in northern Europe, 1957 to 1962, 16: 25619(R) (TID-16272)
determination in gas chromatography effluents using ionization chambers, 16: 25428
determination in water, radiometric, 16: 25592
incorporation in polystyrene, 16: 25433
proton reactions, meson (π) production cross sections, 16: 26260
uptake and distribution in rat organs, 16: 25110 (CEA-2155)
TRITONS
interactions with tritons at 1.9 Mev, cross sections for, 16: 26075 (JINR-P-911)
TRYPTOPHAN
protective effects against whole-body radiation in mice, 16: 25252 (TID-16160)
TUBES
heat transfer and pressure drop in eccentric, 16: 25526 (NYO-9649)
TUMORS
radiation effects on cell division in Ehrlich's ascites, whole-body, 16: 25209
radiotherapy of malignant, effects of leopon on anemia induced during, 16: 25159
radiotherapy of postoperative breast, protective effects of adrenochrome against injuries during, 16: 25256
TUNGSTEN
adsorptive properties for cesium, potassium, sodium, and thorium, 16: 26009
bonding at 900 to 1100°C, diffusion, 16: 25737 (WAL-TR-460.54/1-2)
coatings by anodic treatment and vapor deposition, 16: 25701 (WADD-TR-61-64)
conference on, University of Sheffield, Sept. 1960, 16: 25708
corrosion, effects of surface saturation with silicon, 16: 25721(T) (PTD-TT-61-31(p.60-9))
determination in niobium and its alloys, 16: 25294
dislocation-relaxation spectra of cold-worked, 16: 25807 (GA-1745)
enthalpy and thermal capacity at 2400 to 2820°C, 16: 25779
fabrication of powders into crucible susceptors, 16: 25704
neutron capture cross sections, 16: 26509
neutron scattering, fast, 16: 26505 (TID-13546)
phase transition in alloyed and unalloyed, effects of interstitials on ductile-to-brittle, 16: 25751 (DMIC-Memo-155)
preparation of yttrium scavenged, by arc-melting, 16: 25696(R) (DRI-2010)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351
TUNGSTEN BORIDES
thermodynamic properties at 300 to 1200°K, 16: 25401
TUNGSTEN CARBIDE–URANIUM CARBIDE SYSTEMS
free energy of formation, 16: 25833
TUNGSTEN FLUORIDES
magnetic susceptibility, 16: 25347
reactions with nitrogen oxides, 16: 25339 (GAT-T-969)
TUNGSTEN ISOTOPES W-180
decay scheme, 16: 26255
TUNGSTEN POWDERS
fabrication of powders into crucible susceptors, 16: 25704

U

ULTRASONICS
therapeutic effects on animal tissues, 16: 25219
use in cleaning organic moderated fuel elements, 16: 25700(R) (NYO-10282)
use of, in determining plasma temperatures, 16: 26404 (RAD-TR-61-13)
wave interactions in ferromagnetic material, 16: 25882 (ASD-TR-61-630)
ULTRAVIOLET RADIATION

measurement, 16: 25595
UNDERGROUND EXPLOSIONS
detection, development of digitization system for seismic records for, 16: 25610 (AFCRL-863)
ground lift and dispersion control in, 16: 25640
seismic decoupling for, in spherical cavities, 16: 25633 (UCRL-6086 (Rev.))
shock wave propagation from, 16: 25639
UNITED KINGDOM ATOMIC ENERGY AUTHORITY
radioisotope handling and shipping facilities, 16: 25673
shipping regulations for highly radioactive materials, 16: 25671
URANIUM
adsorption on resins, 16: 25465 (ACCO-26)
analysis, 16: 25085 (JAERI-7022)
analysis for dysprosium, erbium, gadolinium, and samarium, spectrographic and spectrophotometric, 16: 25266 (CNEN-135)
bonding of nickel-plated to aluminum, metallographic studies, 16: 25817
chemical properties in lithium chloride-potassium chloride eutectic, 16: 25306 (CEA-2125)
coating particles with ceramics or metals, 16: 26479 (TID-7622(p.98-107))
content in rocks in New Hampshire, geologic mapping, 16: 25618(R) (TID-15225)
corrosion during long-term storage, effects of coatings on, 16: 25713 (BMI-1563)
deposition in blood and organs in rabbits, 16: 25158
determination in lead foil, activation, 16: 25281
determination in meteorites, neutron activation, 16: 25623
determination of ratio with molybdenum in hexafluoride mixtures, spectrometric, 16: 25313 (K-1433)
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
diffusion of fission products from, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
dissolution of, in uranium oxide mixtures, procedure for selective, 16: 25483
energy levels, isotopic shifts in, 16: 26360
equation of state in critical region, 16: 25376
fabrication into rods, 16: 25085 (JAERI-7022)
fast fission factor for natural, 16: 26532 (BNL-5604; BNL-5892)
handling, safety procedures for, 16: 25678
ion exchange, 16: 25465 (ACCO-26)
ion exchange, from Utex ore leach solutions, 16: 25466 (ACCO-43)
lattice strains in beta-quenched, 16: 25788
metallurgical effects on radioinduced phase transformations in zirconium oxides, 16: 25861
microstructure, effects of carbon, molybdenum, and zirconium, 16: 25785
neutron flux distribution in natural, equilibrium, 16: 26529
production processes and equipment, review, 16: 25471
proton fission at 660 Mev, charge spectra from, 16: 26329
radiation effects on swelling, design of capsule for studying, 16: 25840 (HW-65453)
radiation effects on density and dimensional changes in gamma, 16: 25862 (AERE-R-3468)
radiation effects, basic swelling studies, 16: 26467(R) (HW-73100)
separation by solvent extraction, comparison with ion exchange, 16: 25490
separation from acid leach solutions by ion exchange, self-elution problems in, 16: 25463 (ACCO-12)
separation from dilute carbonate media, 16: 25487
separation from fission products by solvent extraction, improvement of process for, 16: 25494(P)
separation from ores, 16: 25464(R) (ACCO-15)
separation from plutonium by solvent extraction with liquid metals, 16: 25474 (IS-470)
solubility in bismuth, effects of alkali metals, 16: 25815 (BNL-5156)
solvent extraction with triisooctylamine, 16: 25482(T) (AEC-tr-5197)
solvent extraction from sulfuric acid-leached ores, development of contactor for, 16: 25468 (NCL/AE-197)
thermal cycling, 16: 25085 (JAERI-7022)
thermal cycling effects on rods, 16: 25766(T) (AEC-tr-5076)
thermodynamic properties in critical region, 16: 25376
thermodynamic properties, 16: 25400
uses as alloying additions in steel, radiation and toxicity hazards, 16: 25664
uses, review of non-nuclear, 16: 25707
work function, 16: 25808 (AERE-R-3819)
URANIUM ALLOYS
radiation effects on density and dimensional changes in, 16: 25862 (AERE-R-3468)
URANIUM BORIDES
free energy of formation, 16: 25375
URANIUM CARBIDE COMPACTS
fabrication into fuel elements in France, 16: 25703(T) (AEC-tr-5216)
URANIUM CARBIDES
free energy in carbide solid solutions, 16: 25833
free energy of formation, 16: 25375
hydrolysis at 25 to 100°C, 16: 25341 (ORNL-TM-38 and Rev.1))
thermal capacity, 16: 25379
thermodynamic properties from vaporization measurements, 16: 25393
URANIUM(III) CHLORIDES
free energy of formation at 500°C, 16: 25392
URANIUM COMPLEXES
determination in solutions by solvent partition, 16: 25368
URANIUM CRYSTALS
growth of large alpha-, 16: 25329(T) (AEC-tr-5249)
URANIUM DEPOSITS (SOVIET UNION)
geochemistry of granitic, 16: 25627
URANIUM FLUORIDES
book: *Chemistry and Production of Uranium Fluoride Compounds*, 16: 25470
production and properties, review, 16: 25470
URANIUM(IV) FLUORIDES
analysis for carbon, infrared spectrophotometric, 16: 25283 (TID-12773)
URANIUM(VI) FLUORIDES
reactions with ammonium fluoride, 16: 25469
reactions with nitrogen oxides, 16: 25339 (GAT-T-969)
URANIUM(IV) IONS
sorption by humus, 16: 25364
URANIUM(VI) IONS
sorption by humus, 16: 25364
URANIUM ISOTOPES
content in minerals, age estimation by, 16: 25626
separation by gaseous diffusion, concentration control in plant for, 16: 25686 (CEA-2160)
URANIUM ISOTOPES U-233
criticality studies, 16: 26533 (TID-13176)
fission of, energy and time dependence of delayed gamma emission from, 16: 26222 (LAMS-2642)
neutron capture-to-fission cross section ratios at 30 to 1000 kev for, 16: 26510 (TID-12896)
neutron cross sections, least square analysis of 2200 m/sec, 16: 26216 (BNL-722)
neutron cross sections, 16: 26505 (TID-13546)
neutron fission to 15 Mev, prompt-neutron spectra from, 16: 26514
neutron multiplication in, 16: 26532 (BNL-5604; BNL-5892)
URANIUM ISOTOPES U-234
neutron fission cross sections at 10^5 to 10^7 ev, 16: 26525
neutron fission cross section, 16: 26505 (TID-13546)
URANIUM ISOTOPES U-235
critical mass calculations, sensitivity to changes in neutron scattering data, 16: 26541
criticality studies, 16: 26533 (TID-13176)
fission of, energy and time dependence of delayed gamma emission from, 16: 26222 (LAMS-2642)
neutron capture-to-fission cross section ratios at 30 to 1000 kev for, 16: 26510 (TID-12896)
neutron cross sections, least square analysis of 2200 m/sec, 16: 26216 (BNL-722)
neutron cross sections, 16: 26505 (TID-13546)
neutron fission at 0.04 to 3 Mev, prompt-neutron spectra from, 16: 26513
neutron fission cross sections at 0.1 to 1.6 Mev, 16: 26512
neutron fission cross sections at 10^5 to 10^7 ev, 16: 26525
neutron fission to 15 Mev, prompt-neutron spectra from, 16: 26514

neutron reactions at 12 to 19 Mev, multiplication in, 16: 26241
URANIUM ISOTOPES U-236
neutron capture cross section, 16: 26505 (TID-13546)
neutron fission cross sections at 10^3 to 10^7 ev, 16: 26525
URANIUM ISOTOPES U-238
critical mass calculations, sensitivity to changes in neutron scattering data, 16: 26541
fission of, energy and time dependence of delayed gamma emission from, 16: 26222 (LAMS-2642)
neon-22 and nitrogen-14 reactions, production of actinium-225 and -226 in, 16: 25411 (JINR-P-978)
neutron capture cross sections, 16: 26509
neutron cross sections for energy level excitation, 16: 26532 (BNL-5604; BNL-5892)
neutron fission at 14.5 Mev, fission-product energies from, 16: 26355
neutron fission cross sections at 0.1 to 1.6 Mev, 16: 26512
neutron fission cross sections at 10^3 to 10^7 ev, 16: 26525
neutron reactions at 12 to 19 Mev, multiplication in, 16: 26241
neutron scattering, fast, 16: 26505 (TID-13546)
photofission cross sections, 16: 25949 (NP-11977(p.144-6))
URANIUM LEACH SOLUTIONS
ion exchange tests on Utex ore for uranium recovery, 16: 25466 (ACCO-43)
URANIUM LEACH SOLUTIONS (ACID)
preparation and uranium separation from, 16: 25464(R) (ACCO-15)
uranium separation from by ion exchange, self-elution problems in, 16: 25463 (ACCO-12)
URANIUM MINERALS
mineralization in Italian Alps, 16: 25634 (CNEN-53)
URANIUM NITRIDES
heats of formation, 16: 25832
radiation effects, 16: 25839(R) (BMI-X-197)
URANIUM ORES
leaching, comparison of methods for uranium recovery, 16: 25466 (ACCO-43)
leaching tests, 16: 25464(R) (ACCO-15)
processing, equipment and technology for, 16: 25471
URANIUM(IV) OXIDE COMPACTS
fabrication and oxidation resistance of aluminum oxide clad, 16: 25749 (BMI-1586)
fabrication into fuel elements in France, 16: 25703(T) (AEC-tr-5216)
URANIUM(IV) OXIDE POWDERS
properties as reactor core material, 16: 25762 (SCNC-264)
URANIUM OXIDE–YTTRIUM OXIDE SYSTEMS
formation of $UO_{2.00} \cdot 6YO_{1.5}$, kinetics and mechanism of, 16: 25350
URANIUM(IV) OXIDE–ZIRCONIUM OXIDE SYSTEMS
phase studies at 1200 to 2350°C, 16: 25765 (WAPD-253)
URANIUM OXIDES
dispersion in glasses, 16: 26477 (TID-7622(p.74-85))
reactions with divalent metal oxides at high pressure and 900 to 1200°C, 16: 25302 (BMI-1585)
thermal properties of U_3O_7, 16: 25378
thermodynamic properties of non-stoichiometric, 16: 25377
thermodynamic properties, 16: 25388
thermodynamic properties, 16: 25400
vapor pressure, 16: 25371
vaporization processes, 16: 25389
volatile species, 16: 25381
URANIUM OXIDES (STAINLESS STEEL CLAD)
fabrication techniques, 16: 25732 (GNEC-197)
URANIUM(IV) OXIDES
analysis, 16: 25085 (JAERI-7022)
buckling in seven-element clusters in ZED-2, 16: 26461 (CRRP-1072)
coating particles with ceramics or metals, 16: 26479 (TID-7622(p.98-107))
equilibrium oxygen pressure of non-stoichiometric, 16: 25373
fabrication and radiation effects, 16: 26467(R) (HW-73100)
fission product release by diffusion, melting, and oxidation, 16: 26484 (TID-7622(p.149-59))
heat transfer to Zircaloy-2, coefficient of, 16: 25523 (CRFD-1075)
oxidation, heats, 16: 25378
reactions with beryllium, effects of anodic films, 16: 25724
reactions with uranium monosulfide, 16: 25399
vapor pressure, 16: 25403
URANIUM(VI) OXIDES
analysis for sulfate, gravimetric, 16: 25270 (PG-Report-330)
URANIUM OXYSULFIDES
thermodynamic properties, 16: 25399
URANIUM SELENIDES
thermodynamic properties, 16: 25388
URANIUM SILICIDES
heats of formation, 16: 25832
URANIUM SULFIDES
reactions with uranium dioxide, 16: 25399
thermodynamic properties, 16: 25388
thermodynamic properties, 16: 25399
URANIUM TELLURIDES
thermodynamic properties, 16: 25388
URANIUM, TETRACYCLOPENTADIENYL-
preparation and properties, 16: 25369
URANIUM–ZINC ALLOYS
thermodynamic properties at 450°C, 16: 25397
URANIUM–ZIRCONIUM ALLOYS
diffusion of hydrogen in delta-phase, theoretical kinetics and stresses of, 16: 25756 (NAA-SR-6264)
dissolution in anhydrous hydrogen fluoride–hydrogen chloride at 400 to 450°C, 16: 25710(P)
microstructure characteristics, 16: 25785
URANYL AZIDE COMPLEXES
spectrophotometry, continuous variation method of, 16: 25352
URANYL IONS
sorption by carboxylated cellulose, spectroscopic analysis of, 16: 25336
URANYL NITRATES
analysis for sulfate, gravimetric, 16: 25270 (PG-Report-330)
URANYL SULFATES
equilibrium with anionic XX resin, 16: 25330
ion exchange kinetics with strong base anion resin, 16: 25478 (ORNL-3296)
URETHAN POLYMERS
radiation effects on engineering properties, 16: 25843 (NARF-62-5T)
URINE
analysis for radioisotopes, bibliography on, 16: 25268 (JAERI-4020)

V

VACUUM GAGES
calibration system, 16: 25553 (GCA-TR-61-19-N)
VACUUM PUMPS
design of multi-beam, gas-discharge, 16: 25511(T,P) (FTD-TT-62-370)
VALVES
design of fluid flow control system for ducts, 16: 25538(P)
design of sampling, for reactor coolant, 16: 26462 (DP-658)
VAN DE GRAAFF ACCELERATORS
alpha particle acceleration in tandem, 16: 25910(R) (NP-11749)
VANADIUM
chemical properties in lithium chloride-potassium chloride eutectic, 16: 25306 (CEA-2125)
corrosion by impurities in liquid metal coolant in Dounreay Fast Reactor, 16: 26475 (TID-7622(p.35-56))
determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
determination using aniline, benyidine, or α-naphthylamine qualitative, 16: 25276(T) (AEC-tr-5250)
neutron capture cross sections, 16: 26509
phase transition in alloyed and unalloyed, effects of interstitials on ductile-to-brittle, 16: 25751 (DMIC-Memo-155)
specific heat at low temperatures, 16: 25806
VANADIUM IONS
separation of tetra- and pentavalent, from 25 metal ions by cation exchange, 16: 25484 (IS-415)
VANADIUM ISOTOPES V-51
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
proton reactions (p,n) at 17 Mev, effects of excited isobaric states, 16: 26333 (UCRL-6830)

VAPOR PRESSURE
isotopic effects, 16: 25304 (BNL-6050)
VAPORIZATION
of metal oxides, measurement, 16: 25403
of volatile oxides, methods for studying, 16: 25381
processes, studies, 16: 25389
VENTILATION
equipment for clean rooms, 16: 25509 (TID-16274)
systems for radioisotope laboratories, 16: 25676
VIRIAL COEFFICIENTS
calculation of second, for general polyreciprocal potentials, 16: 25875 (AFSWC-TDR-62-21)
calculation of second, for ion-neutral interactions, tables for, 16: 25875 (AFSWC-TDR-62-21)
tables of second, and their derivatives for constituent pairs involving neutral species in high-temperature air, 16: 25875 (AFSWC-TDR-62-21)
VIRUSES
demonstration in tissues of mice with radioinduced leukemia, 16: 25199
VITAMIN B
transport across intestinal wall, effects of whole-body irradiation, 16: 25180 (TID-16271)
VITAMIN B_{12}
protective effects against radiation injuries in mice, 16: 25253
VITAMINS
protective effects of B_{12} against radiation injuries in mice, 16: 25253

W

WASTE DISPOSAL
bibliography, 16: 25476 (ORNL-2971(Vol.4))
contamination problems in, survey, 16: 25677
design of cement containers for sea, 16: 26641 (TID-15431)
methods using tanks and retention basins for radioactive liquids from 300 Area at Hanford, 16: 26637 (HW-64292)
survey of methods, 16: 26636(R) (EURAEC-84)
WASTE PROCESSING
calcination, 16: 26639(R) (HW-73412)
calcination, 16: 26640 (ORNL-TM-259)
equipment and methods for liquid from hot laboratory, Würenlingen, Switzerland, 16: 26635 (EIR-24)
incineration, leaching, and solidification, 16: 26636(R) (EURAEC-84)
solvent extraction, 16: 26639(R) (HW-73412)
sorption on ion exchange materials, 16: 26639(R) (HW-73412)
vitrification of concentrated fission product solutions, 16: 26634 (CEA-2130)
WASTE SOLUTIONS
monitoring using salmon, 16: 25143(R) (HW-72500(p.144-7))
recovery of strontium-90, 16: 25651 (HW-71574)
separation of cesium and strontium from condensate, containing ammonia, 16: 26638 (HW-71627)
WATER
absorption from intestine to lymph and blood, tracer study, 16: 25130(R) (HW-72500(p.84-7))
analysis for dissolved oxygen, radiometric, 16: 25282
analysis for heavy water in Concepción Region, Chile, 16: 25621
analysis for tritium, radiometric, 16: 25592
determination in brown coal by elastic back-scattering of fast neutrons, 16: 25296
determination in coal by neutron moderation, 16: 25682(R) (TID-16013)
drop coalescence at planar interface with anisole, hydrodynamic mechanism for, 16: 25956 (UCRL-10097)
heat transfer and pressure drop in eccentric annuli, 16: 25526 (NYO-9649)
heat transfer in boiling, electroconvection effects on, 16: 25533
molecular structure and solvent properties, 16: 25327(T) (AEC-tr-5126)
neutron diffusion in, extrapolation distances for, 16: 26208
neutron spectrum measurements in, extraction hole effects on thermal, 16: 26199 (NP-11932)
physical and thermodynamic properties of, effects of isotopic substitutions on, 16: 25307 (CEA-Bib-15)
potentials of nickel electrode in, 16: 25322 (TID-16292)
radiolysis mechanism, 16: 25462
reactions with benzyl chlorides, chlorine isotope effects in, 16: 25344
solvent properties for oxygen with and without platinum catalyst, 16: 25324 (TID-16392)
WATER-*d*
physical and thermodynamic properties review, 16: 25307 (CEA-Bib-15)
WATER-d_2
content in natural waters of Concepción Region, Chile, 16: 25621
effects on growth and respiration of yeast, 16: 25137(R) (HW-72500 (p.113-18))
losses in Plutonium Recycle Test Reactor, 16: 26616 (HW-73735)
neutron scattering at 0.0026 to 10.4 kev, spectra from, 16: 25586
physical and thermodynamic properties review, 16: 25307 (CEA-Bib-15)
separation from fission products in slurry type reactor by distillation, 16: 25496(P)
solvent properties for helium at high pressures and 50 to 280°C, 16: 25303 (BMI-1587)
WATER-*t*
physical and thermodynamic properties review, 16: 25307 (CEA-Bib-15)
WATER-t_2
physical and thermodynamic properties review, 16: 25307 (CEA-Bib-15)
WATER COOLED REACTORS
burnout and pressure drop in steam-water systems for, 16: 25530(T) (EURAEC-42)
development of Euratom CAN-1, 16: 26603(T,R) (EURAEC-36)
development of Euratom CAN-1, 16: 26604(T,R) (EURAEC-38)
fuel cycles and loading programming for, 16: 26620 (ORNL-TM-277)
power monitoring, Cherenkov detector, 16: 25597(P)
WATER VAPOR
corrosive effects on beryllium above 500°C, 16: 25725
determination in lunar atmosphere, 16: 26049
determination, neutron moderation method, 16: 25271(R) (TID-16156)
electron quasi-trapping in, low-energy, 16: 25973
WELDING
conference, AWS and ASME, Cleveland, Ohio, April 9 to 13, 1962, 16: 25741
development of gas shielded-arc, 16: 25740
WELL LOGGING
gamma/gamma, equipment and method for locating coal, 16: 25637
WHEAT
beta radioactivity and potassium content in, 16: 25644 (CLOR-9)
effects of radiation and chemical mutagens on growth, 16: 25194 (CNEN-124)
radioinduced mutants, 16: 25195 (CNEN-126)
radioinduced mutations, 16: 25196 (CNEN-120)
WIND
profile in lowest 400 feet of the atmosphere, 16: 25611 (BNL-718)
WIND TUNNELS
applications in the study of wind profiles, 16: 25611 (BNL-718)
design of ARGMA 8000-kw plasma, for reentry simulation, 16: 25499 (ARGMA-TN-2H5N)
WINDSCALE ADVANCED GAS COOLED REACTOR
cost factors, 16: 26606
WITWATERSRAND GOLD FIELDS (UNION OF SOUTH AFRICA)
ore analysis, radiochemical examination of errors in, 16: 25635

X

X RADIATION
effects on abortion, infant death, and sterility in off-spring of workers, 16: 25214
effects on biochemical events in regenerating liver, 16: 25132(R) (HW-72500(p.92-6))
effects on blood pressure in rats, whole-body, 16: 25222
effects on cell division in Ehrlich's ascites tumors, whole-body, 16: 25209
effects on cerebral cortex and subcortex of prenatally exposed rabbits, 16: 25247
effects on development of Ephestia larvae, 16: 25134(R) (HW-72500 (p.102-3))
effects on development, growth, and sensitivity of Yoshida ascites sarcomas, 16: 25221

effects on DNA and RNA content in chick embryo, 16: 25207
effects on DNA and RNA in liver and spleen, 16: 25208
effects on electroencephalographic pattern and adrenaline sensitivity in rabbits, prenatal exposure, 16: 25244
effects on eyes in developing mouse embryos, 16: 25215
effects on fetus after male exposure, protective effects of S-β-aminoethylisothiuronium against, 16: 25211
effects on gonads, protective effects of casein against, 16: 25233
effects on heartbeat of frog, 16: 25216
effects on liver lipid metabolism, whole-body exposure, 16: 25178(R) (TID-16131)
effects on mast cells in rats skin, 16: 25206
effects on morphology and metabolite transport of intestinal wall, whole-body exposure, 16: 25179 (TID-16270)
effects on morphology and metabolite transport of intestinal wall, whole-body exposure, 16: 25180 (TID-16271)
effects on nervous system of rat progenies, antenatal exposure, 16: 25240
effects on nucleic acid metabolism in mice, 16: 25212
effects on oxidation in bacteria, protective effects of cysteine against, 16: 25223
effects on oxygen consumption in bone marrow in guinea pigs, 16: 25204
effects on plant metabolism, 16: 25135(R) (HW-72500(p.104-8))
effects on sedimentation coefficients of DNA from *E. coli*, 16: 25218
effects on unsaturation variations in serum lipids in rabbits, 16: 25229
effects on work capacity and life span of dogs, 16: 25183(R) (UCD-105)
genetic effects on chromosomes in root meristems, 16: 25217
induction of anti-infection mechanisms in mice, protective effects of cysteine against, 16: 25258
induction of leukemia following whole-body, in mice, 16: 25199
lethal dosage measurements for two species of flour beetle, *Tribolium confusum* and *Tribolium castaneum*, 16: 25146(R) (HW-72500(p.156-8))
mutation induced in tomatoes by exposure by seeds, 16: 25197 (CNEN-119)
mutations in wheat induced by, 16: 25196 (CNEN-120)
protective effects of monoamine oxidase inhibitors against whole-body, in mice, 16: 25252 (TID-16160)
scattering by fog, use in estimating steam quality in pipes, 16: 25551 (CRRP-1086)
synergistic effects with chemical mutagens, on tobacco seeds, 16: 25193 (CNEN-118)
synergistic effects with actinomycin D on cell growth in tissue cultures, 16: 25232

X-RAY-ABSORPTION ANALYSIS
book: *Advances in X-Ray Analysis*. Vol. 5. Proceedings of the Tenth Annual Conference on Application of X-Ray Analysis, Denver, Colorado, August 7 to 9, 1961, 16: 25298

X-RAY SPECTROSCOPY
alignment procedures and spurious spectral effects in two-crystal, 16: 25545 (AFOSR-2418)

XENON
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
meson (π^-) reactions at 2.8 Bev, K^0 and Λ^0 production in, 16: 26189
oxygen ion elastic scattering at 153 Mev, 16: 25990
reactions with helium, ionization cross sections, 16: 26238
release from irradiated thorium carbide-uranium carbide systems in graphite matrix at 900 to 2000°C, 16: 25752 (GA-3211)
separation from flowing helium stream by fixed-bed adsorption, 16: 26489 (TID-7622(p.218-35))
transport coefficients at high temperatures, 16: 25880 (ARL-62-328)

XENON ISOTOPES Xe-132
gamma emission, directional correlations of, 16: 26246

XENON ISOTOPES Xe-133
diffusion in single-crystal alpha-alumina, 16: 26491 (TID-7622(p.245-53))

XENON ISOTOPES Xe-137
determination in fission gases, spectrometric, 16: 25295

XENON ISOTOPES Xe-138
determination in fission gases, spectrometric, 16: 25295

XENON ISOTOPES Xe-139
determination in fission gases, spectrometric, 16: 25295

XENON ISOTOPES Xe-140
determination in fission gases, spectrometric, 16: 25295

XENON ISOTOPES Xe-141
determination in fission gases, spectrometric, 16: 25295

XYLENE
solvent effects in tertiary amine extraction of iron in hydrochloric acid, 16: 25481 (PAN-303/V)

Y

YANKEE POWER REACTOR
control rod characteristics of cadmium-indium-silver alloys in, 16: 25796
materials for, properties of concrete, 16: 25781

YEASTS
effects of deuterium oxide on growth and respiration, 16: 25137(R) (HW-72500(p.113-18))
metabolism of thymidine during cell division, tracer study, 16: 25136(R) (HW-72500(p.109-12))
radiomimetic action of oxidized oleic acid on, effects of oxygen, 16: 25200

YTTERBIUM
neutron capture cross sections, 16: 26509
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)

YTTERBIUM COMPLEXES
with dicyclopentadienyl acetate, amide, benzoate, formate, methoxide, and phenoxide, synthesis, 16: 25321(R) (TID-16224)

YTTERBIUM ISOTOPES Yb-169
energy levels and gamma spectra, 16: 26254

YTTERBIUM ISOTOPES Yb-175
energy levels and gamma spectra, 16: 26254

YTTERBIUM ISOTOPES Yb-177
energy levels and gamma spectra, 16: 26254

YTTRIUM
determination in silicate rocks, combined cation exchange-spectrochemical, 16: 25287
determination in yttrium and samarium oxides, activation, 16: 25292
determination, micro-coulometric, 16: 25285
neutron capture cross sections, 16: 26509
properties as nitrogen and oxygen scavenger in molybdenum and tungsten, 16: 25696(R) (DRI-2010)
separation from methanol-nitric acid systems using anion exchange resins, 16: 25280 (TID-15598)
vapor pressure at 1360 to 1760°K, 16: 25405

YTTRIUM COMPLEXES
equilibrium quotients and stability of bromide and chloride, 16: 25356

YTTRIUM DEUTERIDES
thermodynamic properties, 16: 25395

YTTRIUM FERRATES
magnetic interactions and spin arrangements in garnets, 16: 25882 (ASD-TR-61-630)

YTTRIUM HYDRIDES
thermodynamic properties, 16: 25395

YTTRIUM ISOTOPES Y-89
energy levels, excitation energies and spins for, 16: 26287 (IS-408)
neutron capture cross sections at 10^3 to 10^5 ev, 16: 26518
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)

YTTRIUM ISOTOPES Y-90
distribution and retention in trout, 16: 25117(R) (HW-72500(p.26-9))
pathological effects of ingested, 16: 25131(R) (HW-72500(p.88-91))

YTTRIUM ISOTOPES Y-93
beta decay, mass discrepancies from, 16: 26287 (IS-408)

YTTRIUM ISOTOPES Y-95
beta decay, mass discrepancies from, 16: 26287 (IS-408)

YTTRIUM OXIDES
analysis, neutron activation, 16: 25292
crystal structure and phase studies, 16: 25350
thermodynamic properties, 16: 25386

Z

ZINC

determination in stratospheric aerosols, 16: 25609 (AFCRL-62-299)
determination, micro-coulometric, 16: 25285
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
meson (μ) x-ray transition energies for, 16: 25909 (NEVIS-105)
neutron capture cross sections, 16: 26509
neutron scattering at 3.4 to 4.6 Mev, angular distributions, 16: 26507
properties, theory of infrared and optical, 16: 25758 (NP-11675)
proton reactions (p,n) at 14.8 Mev, neutron spectra from, 16: 26326 (UCRL-6733)
surface tension of liquid, relation to critical temperature and surface energy, 16: 25351

ZINC ISOTOPES
proton reactions (p,α) at 17 Mev on even, effects of excited isobaric states, 16: 26333 (UCRL-6830)

ZINC ISOTOPES Zn-65
distribution in tissues, tracer study, 16: 25133(R) (HW-72500(p.97-101))
electron capture decay, K-shell fractions, 16: 26336

ZINC OXIDES
reactions with uranium oxides at high pressure and 900 to 1200°C, 16: 25302 (BMI-1585)

ZINC SULFIDE CRYSTALS
electric conductivity and luminescence of copper-activated, 16: 25413(R) (NP-11882)
preparation and electrical and optical properties, 16: 25878 (ARL-62-319)

ZIRCONIUM
contents in granites and zircons, 16: 25629
contents in minerals and rocks, ratio to hafnium, 16: 25631
deformation, stored energy increase and release after, 16: 25821
determination in niobium and its alloys, 16: 25294
determination in thorium-zirconium alloys, spectrophotometric, 16: 25284
deuteron reactions (d,p) at 13.6 Mev, proton spectra from, 16: 26356
diffusion from irradiated uranium, effects of burnup and irradiation level on, 16: 25841 (HW-72321)
fatigue, effects of applied stress and hydrogen sorption on static, 16: 25746(R) (ARF-2230-9)
metallurgical effects on creep and tensile properties of aluminum-titanium alloys, 16: 25820
neutron capture cross sections, 16: 26509
neutron resonance absorption integrals for, 16: 26511
neutron scattering, fast, 16: 26505 (TID-13546)
separation from hafnium and iron by ion exchange, 16: 25278(T) (SCL-T-423)
solubility in copper, 16: 25794
solvent extraction with triisooctylamine, 16: 25482(T) (AEC-tr-5197)
thermodynamic properties, 16: 25406

ZIRCONIUM BORIDES
thermodynamic properties at 3000°K and in different atmospheres, 16: 25747 (ASD-TDR-62-204(Pt.I))
thermodynamic properties at 300 to 1200°K, 16: 25401

ZIRCONIUM CARBIDES
thermal properties at 450 to 1820°C, 16: 25837(R) (AD-270841)
thermodynamic properties at 3000°K and in different atmospheres, 16: 25747 (ASD-TDR-62-204(Pt.I))

ZIRCONIUM COMPLEXES
with montmorillonite, fixation of phosphoric ions on, 16: 25305 (CEA-1650)

ZIRCONIUM DEUTERIDES
thermodynamic properties, 16: 25395

ZIRCONIUM HYDRIDES
neutron diffusion and thermalization in, 16: 26207
thermodynamic properties, 16: 25395

ZIRCONIUM ISOTOPES
neutron configurations in, 16: 26319

ZIRCONIUM ISOTOPES Zr-92
energy level strength functions for, 16: 26518

ZIRCONIUM ISOTOPES Zr-93
production in yttrium-93 decay, mass discrepancies from, 16: 26287 (IS-408)

ZIRCONIUM ISOTOPES Zr-94
energy level strength functions for, 16: 26518

ZIRCONIUM ISOTOPES Zr-95
production in yttrium-95 decay, mass discrepancies from, 16: 26287 (IS-408)

ZIRCONIUM OXIDES
radioinduced phase transformations in, effects of uranium doping, 16: 25861
vaporization rate in air, 16: 25403

ZIRCONIUM PHOSPHATES
ionic conductivity, 16: 25349

ZIRCONIUM POWDERS
handling hazards and safety procedures in, 16: 25670

ZIRCONS
hafnium and zirconium contents, 16: 25629

ZIRCONYL FLUORIDES
hydrolysis products, composition, 16: 25326(T) (AEC-tr-5117)

REPORT NUMBER INDEX

All reports, translations, and patents abstracted in this issue are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

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62-251(I)	16-25612	See HW-71400(Vol.I)
62-299	16-25609	OTS
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2418*	16-25545	
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3030*	16-25546	
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60-871*	16-25318	See RAD-TM-60-44
AFSWC-TDR–	(Non-AEC)	
62-21	16-25875	
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105(Suppl.1)	16-26583	Dep.(mc); $2.60(fs), $0.92(mf) OTS
APAE-Memo–	(Misc.)	
279	16-26456	Dep.(mc); $3.60(fs), $1.28(mf) OTS
APEX–		
652	16-26432	Dep.(mc); $3.60(fs), $1.19(mf) OTS
729	16-26457	Dep.(mc); $1.10(fs), $0.80(mf) OTS

Report No.	Abstract No.	Availability
ARF–	**(Misc.)**	
1167-18	16-25521	Dep.; $2.25(OTS)
1184-5	16-25838	Dep.(mc); $3.60(fs), $1.22(mf) OTS
2230-9	16-25746	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ARGMA-TN–	**(Non-AEC)**	
2HSN	16-25499	
ARL–	**(Non-AEC)**	
62-319	16-25878	OTS
62-320	16-25879	OTS
62-328	16-25880	$2.75(OTS)
62-332	16-26066	
62-357	16-25693	$2.25(OTS)
62-358	16-25300	$1.75(OTS)
AROD–	**(Misc.)**	
2302.8*	16-25547	
2543.5*	16-26215	
2763.9*	16-25548	
ASD-TDR–	**(Non-AEC)**	
7-785(VI)	16-25729	
62-52	16-25549	OTS
62-204(Pt.I)	16-25747	OTS
62-272	16-25694	OTS
62-476	16-25748	OTS
ASD-TN–	**(Non-AEC)**	
61-160	16-25881	OTS
ASD-TR–	**(Non-AEC)**	
61-11(Vol.I)	16-25080	OTS
61-201	16-26627	OTS
61-594	16-25522	OTS
61-630	16-25882	OTS
62-7-647	16-25730	
BAW–	**(Misc.)**	
183*	16-26458	Dep.(mc); $14.50(fs), $6.77(mf) OTS
BLG-B–	**(Belgian)**	
1	16-25301	Dep.(mc)
4	16-25265	Dep.(mc)
BM-RI–	**(Misc.)**	
6022*	16-25408	Free(Bureau of Mines)
BMI–	**(Misc.)**	
1563	16-25713	Dep.(mc); $3.60(fs), $1.16(mf) OTS
1585	16-25302	Dep.; $0.50(OTS)
1586	16-25749	Dep.; $0.50(OTS)
1587	16-25303	Dep.; $0.50(OTS)
BMI-X–		
188	16-25695	Dep.(mc); $1.10(fs), $0.80(mf) OTS
196	16-25750	Dep.(mc); $1.60(fs), $0.80(mf) OTS
197	16-25839	Dep.(mc); $1.10(fs), $0.80(mf) OTS
BNL–		
716	16-25604	Dep.; $0.50(OTS)
718	16-25611	Dep.; $1.00(OTS)
722	16-26216	Dep.; $0.75(OTS)
740	16-25409	Dep.; $1.00(OTS)
4850	16-25454	Proc. Chem. Soc. 289-90(1960)
4932	16-25705	Civil Eng. 31: 60-1(1961)
5156	16-25815	Trans. Am. Soc. Metals 54: 201-7(1961)
5522	16-25534	Nuclear Sci. and Eng. 13: 275-82(1962)
5604	16-26532	Included in p.435-43 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962
5770	16-26480	See TID-7622(p.109-20)
5821	16-26209	Nuclear Sci. and Eng. 13: 250-60(1962)
5826	16-26459	Dep.(mc); $7.60(fs), $2.51(mf) OTS
5892	16-26532	Included in p.435-43 of "Physics of Fast and Intermediate Reactors. Vol. I." Vienna, International Atomic Energy Agency, 1962
6050	16-25304	Dep.(mc); $1.10(fs), $0.80(mf) OTS
C–	**(Misc.)**	
62081*	16-25758	See NP-11675
CE–		
1076	16-26497	See TID-16138
CEA–	**(French)**	
1650	16-25305	Dep.(mc)
2012	16-26193	Dep.(mc)
2028	16-25579	Compt. rend 252: 2390-2(1961)
2109	16-26369	Dep.(mc)
2120	16-25410	Dep.(mc)
2123	16-25473	Dep.(mc)
2125	16-25306	Dep.(mc)
2128	16-25550	Dep.(mc)
2130	16-26634	Dep.(mc)
2134	16-26615	Dep.(mc)
2155	16-25110	Dep.(mc)
2157	16-26063	Dep.(mc)
2158	16-26460	Dep.(mc)
2159	16-25642	Dep.(mc)
2160	16-25686	Dep.(mc)
2163	16-25643	Dep.(mc)
CEA-Bib–	**(French)**	
15	16-25307	Dep.(mc)
CEND–	**(Misc.)**	
150(Pt.IV)	16-26584	Dep.; $0.50(OTS)
CERN–	**(European Organization for Nuclear Research)**	
62-17	16-26067	Dep.(mc)
CISE-R–	**(Italian)**	
18	16-26603	For translation see EURAEC-36
CLOR–	**(Polish)**	
9	16-25644	Dep.
11	16-25645	Dep.
CNEN–	**(Italian)**	
53	16-25634	7p. of Ind. mineraria (Rome) 12: (1961)
117	16-25198	Atti assoc. genet. ital. 6: 409-18(1961)
118	16-25193	Atti assoc. genet. ital. 6: 343-52(1961)
119	16-25197	Atti assoc. genet. ital. 6: 381-94(1961)
120	16-25196	Atti assoc. genet. ital. 6: 371-80(1961)
121	16-25192	Atti assoc. genet. ital. 6: 261-76(1961)
124	16-25194	Atti assoc. genet. ital. 6: 353-64(1961)
126	16-25195	Atti assoc. genet. ital. 6: 365-70(1961)
135	16-25266	Dep.(mc)
CNI–	**(Italian)**	
54	16-25166	Dep.(mc)
CRFD–	**(Canadian)**	
1075	16-25523	Dep.; $2.00(AECL)
CRIO–	**(Canadian)**	
1091	16-25081	Dep.; $1.00(AECL)
CRRP–	**(Canadian)**	
1072	16-26461	Dep.; $2.00(AECL)
1086	16-25551	Dep.; $0.50(AECL)
CTSL–		
33	16-25883	Dep.(mc); $3.60(fs), $1.37(mf) OTS
CU–	**(Misc.)**	
212*	16-25909	See NEV15-105
1-61-AEC-187-Ch.E	16-25526	See NYO-9649
CVNA–	**(Misc.)**	
95	16-26585	Dep.(mc); $13.00(fs), $5.69(mf) OTS
108	16-26586	Dep.(mc); $6.60(fs), $2.24(mf) OTS
117(Vol.I)	16-26587	Dep.(mc); $8.60(fs), $2.96(mf) OTS
117(Vol.II)	16-26588	Dep.(mc); $11.50(fs), $4.79(mf) OTS
121	16-26589	Dep.(mc); $12.00(fs), $5.06(mf) OTS
D–	**(Misc.)**	
1-82-0171*	16-25884	
1-82-0172*	16-26400	
1-82-0173*	16-25552	
DC–	**(Misc.)**	
55-11-47	16-25605	Dep.(mc); $3.60(fs), $1.34(mf) OTS
DEG-Inf.Ser.–	**(British)**	
262	16-25510	Dep.
DESY-A–	**(German)**	
1.9	16-26370	Dep.(mc)
DLCS–		

Report No.	Abstract No.	Availability
3960101	16-26590	Dep.(mc); $2.60(fs), $1.07(mf) OTS
4000301(Rev.)	16-26591	Dep.(mc); $7.60(fs), $2.54(mf) OTS
DM–	**(Non-AEC)**	
62-15	16-25728	See AD-270153
DMIC–	**(Non-AEC)**	
169	16-25714	
170	16-25308	
DMIC-Memo–	**(Non-AEC)**	
155	16-25751	
DP–		
658	16-26462	Dep.; $0.50(OTS)
701	16-26463	Dep.; $0.75(OTS)
727	16-25309	Dep.; $0.50(OTS)
737	16-25310	Dep.; $0.50(OTS)
DPR-INF–	**(British)**	
267	16-25082	Free(BIS)
DRI–	**(Misc.)**	
2010*	16-25696	
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EIR–	**(Swiss)**	
24	16-26635	Dep.(mc)
EOS–	**(Non-AEC)**	
2080-ML-7	16-25845	See NP-11759
ER–	**(Misc.)**	
4774*	16-25718	See NP-11952
ERDL–	**(Non-AEC)**	
1691-TR	16-25646	OTS
EURAEC–		
36	16-26603	Dep.; $4.60(fs), $1.46(mf) OTS
38	16-26604	Dep.(mc); $2.60(fs), $0.83(mf) OTS
42	16-25530	Dep.(mc); $16.50(fs), $7.79(mf) OTS
84	16-26636	Dep.(mc); $1.60(fs), $0.80(mf) OTS
164	16-25647	Dep.(mc); $1.10(fs), $0.80(mf) OTS
255	16-26464	Dep.(mc); $4.60(fs), $1.58(mf) OTS
271	16-25695	See BMI-X-188
348	16-25839	See BMI-X-197
349	16-25750	See BMI-X-196
FTD-TT–	**(Non-AEC)**	
61-31	16-25719	OTS
61-241	16-26605	OTS
61-242	16-26376	OTS
62-165	16-26047	OTS
62-354	16-26436	OTS
62-369	16-25576	OTS
62-370	16-25511	OTS
62-637	16-25957	OTS
FZK–	**(Non-AEC)**	
9-174	16-25843	See NARF-62-5T
GA–	**(Misc.)**	
1745	16-25807	Phys. Rev. Letters 6: 273-5(1961)
2241	16-25731	Dep.(mc); $1.10(fs), $0.60(mf) OTS
2395	16-26489	See TID-7622(p.218-35)
2782(Rev.)*	16-25648	
3211	16-25752	Dep.(mc); $2.60(fs), $0.86(mf) OTS
GAMD–	**(Misc.)**	
1318	16-26465	Dep.(mc); $5.60(fs), $1.76(mf) OTS
1722	16-26592	Dep.(mc); $3.60(fs), $1.37(mf) OTS
2089	16-25753	Dep.(mc); $2.60(fs), $0.86(mf) OTS
3168	16-26593	Dep.(mc); $8.10(fs), $2.63(mf) OTS
GAT-T–		
969	16-25339	Inorg. Chem. 1: 661-5(1962)
GCA-TR–	**(Non-AEC)**	
61-19-N	16-25553	
GEAP–	**(Misc.)**	
3876	16-25697	Dep.; $1.50(OTS)
GEMP–		
123	16-26466	Dep.; $1.25(OTS)
GEST–		
2002	16-25885	
GNEC–		
74	16-26594	Dep.(mc); $14.00(fs), $6.23(mf) OTS
82	16-26595	Dep.(mc); $11.00(fs), $4.70(mf) OTS
197	16-25732	Dep.; $3.00(OTS)
HASL–		
118	16-25554	Dep.; $0.50(OTS)
128	16-25649	Dep.; $3.00(OTS)
HMI-B–	**(German)**	
22	16-25083	Dep.(mc)
HW–		
52448	16-25650	Dep.(mc); $1.10(fs), $0.80(mf) OTS
64292	16-26637	$1.10(fs), $0.80(mf) OTS
65453	16-25840	Dep.; $1.60(fs), $0.80(mf) OTS
71400(Vol.I)	16-25612	Dep.; $2.00(OTS)
71574	16-25651	Dep.(mc); $3.60(fs), $1.13(mf) OTS
71627	16-26638	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72321	16-25841	Dep.; $1.25(OTS)
72500	16-25111	Dep.; $3.00(OTS)
73100	16-26467	Dep.; $3.00(OTS)
73412	16-26639	Dep.; $1.25(OTS)
73643	16-26612	Dep.(mc); $4.60(fs), $1.43(mf) OTS
73711	16-25613	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73755	16-26616	Dep.; $1.00(OTS)
IA–	**(Non-AEC)**	
724	16-25267	Dep.(mc)
IDO–		
12021	16-25652	Dep.; $3.00(OTS)
16777	16-26468	Dep.; $0.50(OTS)
16783	16-25555	Dep.; $0.75(OTS)
16784	16-25556	Dep.; $0.50(OTS)
IG-Memo–	**(British)**	
466	16-25311	Dep.(mc)
IS–		
278	16-25689	J. Inorg. & Nuclear Chem. 24: 183-6(1962)
295	16-25262	Acta Cryst. 15: 627-35(1962)
297	16-25337	Inorg. Chem. 1: 485-93(1962)
310	16-25824	Trans. Met. Soc. AIME 224: 770-5(1962)
320	16-25823	Trans. Met. Soc. AIME 224: 751-6(1962)
362	16-25799	Phys. and Chem. Solids 23: 601-10(1962)
408	16-26287	Nuclear Phys. 36: 228-46(1962)
415	16-25484	Anal. Chem. 34: 1080-2(1962)
437	16-25754	Dep.; $0.50(OTS)
454	16-25348	J. Chem. Phys. 36, 3495-6(1962)
470	16-25474	Dep.; $0.75(OTS)
JAERI–	**(Japanese)**	
1029	16-25260	
1030	16-25557	
4020	16-25268	
6010	16-26194	Dep.(mc)
7020	16-25084	
7022	16-25085	
JEN–	**(Spanish)**	
89-DF/I-28	16-26469	Dep.(mc)
90-DO/I-24	16-25312	Dep.(mc)
97-DF/I-30	16-26617	Dep.(mc)
JINR–	**(Russian)**	
D-965	16-26068	Dep.(mc)
E-932	16-26217	Dep.(mc)
E-943	16-26069	Dep.(mc)
E-975	16-26433	Dep.(mc)
E-977	16-26434	Dep.(mc)
E-991	16-26070	Dep.(mc)
P-817	16-26071	Dep.(mc)
P-891	16-26072	Dep.(mc)
P-904	16-26073	Dep.(mc)
P-905	16-26074	Dep.(mc)
P-906	16-26435	Dep.(mc)
P-911	16-26075	Dep.(mc)
P-917	16-26401	Dep.(mc)
P-923	16-26218	Dep.(mc)
P-929	16-26402	Dep.(mc)
P-930	16-26371	Dep.(mc)

Report No.	Abstract No.	Availability
P-931	16-26372	Dep.(mc)
P-938	16-26076	Dep.(mc)
P-942	16-26219	Dep.(mc)
P-949	16-26077	Dep.(mc)
P-950	16-26220	Dep.(mc)
P-960	16-26078	Dep.(mc)
P-964	16-26079	Dep.(mc)
P-972	16-26080	Dep.(mc)
P-973	16-26221	Dep.(mc)
P-974	16-26081	Dep.(mc)
P-978	16-25411	Dep.(mc)
P-979	16-25558	Dep.(mc)
P-981	16-26082	Dep.(mc)
P-1000	16-26083	Dep.(mc)
JPL-TR-	**(Non-AEC)**	
32-147	16-25614	
32-231	16-26628	
JPRS-	**(Non-AEC)**	
13656	16-25958	OTS
13691	16-25659	OTS
13785	16-25261	OTS
K-		
1433	16-25313	Dep.; $0.50(OTS)
KAPL-		
2000-18	16-26470	Dep.; $1.25(OTS)
2206	16-25524	Dep.; $1.00(OTS)
KAPL-M-		
CT-1	16-26195	Dep.(mc); $6.60(fs), $2.21(mf) OTS
RPC-3	16-26196	Dep.(mc); $6.60(fs), $2.18(mf) OTS
KFK-	**(German)**	
69	16-25500	Dep.(mc)
KGO-	**(Swedish)**	
611	16-25086	
KR-	**(Norwegian)**	
14	16-25715	Dep.(mc)
KY-		
399	16-25314	Dep.; $0.50(OTS)
419	16-25653	Dep.; $0.50(OTS)
LAMS-		
2642	16-26222	Dep.; $1.00(OTS)
2706	16-25842	Dep.; $1.75(OTS)
2722	16-26596	Dep.; $0.50(OTS)
LAS-L-		
161-46	16-25271	See TID-16156
LAS-SR-		
161-43	16-25682	See TID-16013
LNF-	**(Italian)**	
62/37	16-25886	Dep.(mc)
MAB-	**(Non-AEC)**	
139-M(F4)	16-25733	
139-M(M5)	16-25501	
180-M(Vol.II)	16-25755	
ME-	**(Misc.)**	
5-62-1	16-25505	See TID-15986
5-62-2	16-25506	See TID-15987
5-62-TN-3	16-25507	See TID-15988
MET-	**(Misc.)**	
575-5891T2	16-25606	See TID-15356
MAA-SR-		
6264	16-25756	Dep.; $1.25(OTS)
6585	16-26597	Dep.; $0.50(OTS)
6734	16-25412	Dep.; $0.50(OTS)
7144	16-26598	Dep.; $2.00(OTS)
7250	16-26223	Dep.; $0.50(OTS)
7293	16-25734	Dep.; $0.75(OTS)
7356	16-26197	Dep.; $1.25(OTS)
MAA-SR-Memo-		
6849	16-25502	Dep.(mc); $4.60(fs), $1.46(mf) OTS
6928	16-25525	Dep.(mc); $3.60(fs), $1.31(mf) OTS
6938	16-26471	Dep.(mc); $2.60(fs), $0.98(mf) OTS
7278	16-25908	Dep.(mc); $3.60(fs), $1.31(mf) OTS

Report No.	Abstract No.	Availability
NAMC-ASL-	**(Non-AEC)**	
1050(Pt.II)	16-25559	
1050(Pt.III)	16-25560	
NARF-	**(Non-AEC)**	
62-5T	16-25843	
NASA-TN-	**(Misc.)**	
D-1139*	16-26052	$1.00(OTS)
NASA-TT-	**(Non-AEC)**	
F-102	16-25768	
NCL-AE-	**(British)**	
172	16-25475	Dep.(mc)
197	16-25468	Dep.(mc)
NDA-	**(Misc.)**	
2164-3	16-26613	Dep.(mc); $17.50(fs), $8.45(mf) OTS
NDL-TR-	**(Non-AEC)**	
7	16-25561	
NEVIS-		
105	16-25909	
NMI-	**(Misc.)**	
7251	16-25735	Dep.(mc); $3.60(fs), $1.16(mf) OTS
9815*	16-25757	
NP-	**(AEC File No. for Non-AEC Reports)**	
11623	16-26084	
11632	16-26085	Dep.(mc)
11636	16-25698	Dep.(mc)
11656	16-25844	
11675	16-25758	
11693	16-26373	Dep.(mc)
11705	16-25562	Dep.(mc)
11726	16-25172	
11728	16-26629	
11735	16-25563	Dep.(mc)
11737	16-26086	Nuovo cimento (10), 25: 942-5(1962)
11740	16-25249	
11749	16-25910	
11753	16-25250	
11758	16-25315	
11759	16-25845	
11760	16-25615	Dep.(mc)
11780	16-26087	Dep.(mc)
11781	16-26088	Dep.(mc)
11784	16-25173	
11813	16-25911	
11815	16-25699	
11816	16-25503	
11817	16-25087	
11822	16-25564	Dep.(mc)
11832	16-26089	Dep.(mc)
11834	16-25269	
11848	16-25912	
11859	16-26198	Dep.(mc)
11860	16-25565	
11861	16-26630	
11865	16-26224	
11876	16-25716	OTS
11882	16-25413	
11883	16-25566	
11884	16-25167	
11889	16-26374	Dep.(mc)
11890	16-25759	
11892	16-25913	
11904	16-25168	Dep.; 1s. 6d.(HMSO)
11913	16-26225	
11914	16-25616	Dep.(mc)
11920	16-25914	Dep.(mc)
11921	16-25316	Dep.(mc)
11929	16-25846	OTS
11932	16-26199	Dep.(mc)
11936	16-25915	Dep.(mc)
11947	16-25567	
11948	16-25717	

Report No.	Abstract No.	Availability
11952	16-25718	
11977	16-25916	Dep.(mc)
HP-tr-	**(AEC File No. for Non-AEC Translations)**	
883	16-26406	
885	16-26234	Dep.(mc); $6.60(fs), $2.12(mf) JCL
887	16-25512	Dep.(mc); $1.60(fs), $0.80(mf) JCL
888	16-25513	Dep.(mc); $3.60(fs), $1.31(mf) JCL
889	16-25514	Dep.(mc); $2.60(fs), $0.95(mf) JCL
892	16-25515	Dep.(mc); $1.60(fs), $0.80(mf) JCL
902	16-25577	Dep.(mc); $1.60(fs), $0.80(mf) JCL
HUMEC-P-		
100	16-25736	Dep.(mc); $6.60(fs), $2.27(mf) OTS
HYO-		
7062	16-25772	Acta Met. 9: 755-63(1961)
9515	16-26127	Phys. Rev. 126: 2188-96(1962)
9644	16-25568	Dep.(mc); $6.60(fs), $2.09(mf) OTS
9649	16-25526	Dep.; $2.00(OTS)
9837	16-25317	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9949(Pt.IV)	16-26584	See CEND-150(Pt.IV)
10131	16-26226	Dep.(mc); $2.60(fs), $0.83(mf) OTS
10184	16-25414	Dep.(mc); $2.60(fs), $1.10(mf) OTS
10233	16-26090	Dep.(mc); $2.60(fs), $1.07(mf) OTS
10234	16-26091	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10282	16-25700	Dep.(mc); $2.60(fs), $1.01(mf) OTS
ORNL-		
2971(Vol.4)	16-25476	Dep.; $3.50(OTS)
3114	16-25847	Dep.; $8.60(fs), $2.99(mf) OTS
3251	16-26227	Dep.; $0.75(OTS)
3273	16-25477	Dep.; $1.60(fs), $0.80(mf) OTS
3275	16-25848	Dep.; $1.60(fs), $0.80(mf) OTS
3281	16-25760	Dep.; $1.75(OTS)
3287	16-26200	Dep.; $1.00(OTS)
3296	16-25478	Dep.; $2.00(OTS)
3309	16-25415	Dep.; $1.00(OTS)
ORNL-TM-		
38 & Rev. 1	16-25341	Inorg. Chem. 1: 683-87(1962)
173	16-26618	Dep.(mc); $4.60(fs), $1.64(mf) OTS
203(Add.)	16-26619	Dep.(mc); $1.10(fs), $0.80(mf) OTS
259	16-26640	Dep.(mc); $1.60(fs), $0.80(mf) OTS
277	16-26620	Dep.(mc); $3.60(fs), $1.13(mf) OTS
278	16-25654	Dep.(mc); $3.60(fs), $0.95(mf) OTS
288	16-25479	Dep.(mc); $1.10(fs), $0.80(mf) OTS
PA-TR-	**(Non-AEC)**	
1690	16-25088	
PAN-	**(Polish)**	
270/V	16-25480	Dep.
279/I-A	16-25950	Dep.
284/IX	16-26201	Dep.
289/ChR	16-25416	Dep.
293/I-A	16-25504	Dep.
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301/XVIII	16-26403	Dep.
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330	16-25270	Dep.; $0.21(BIS)
PST-Cat.-	**(Misc.)**	
565-566	16-25422	See AEC-tr-4576
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PWA-	**(Non-AEC)**	
2088	16-25761	
R-	**(Misc.)**	
131*	16-26397	See AD-269051
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RAD-TM-	**(Non-AEC)**	
60-44	16-25318	
RAD-TR-	**(Non-AEC)**	
61-13	16-26404	OTS
RAI-		
306	16-25418	Dep.(mc); $5.60(fs), $1.79(mf) OTS
RISÖ-	**(Danish)**	
41	16-25169	Dep.(mc)
RM-	**(Misc.)**	
2825-PR*	16-26631	OTS
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RRL-	**(Misc.)**	
84	16-25419	Dep.(mc); $1.60(fs), $0.80(mf) OTS
RT-EL-	**(Italian)**	
(62) 3	16-25563	See NP-11735
SB-	**(Non-AEC)**	
403(Rev.)	16-25685	$0.10(OTS)
62-12	16-25846	See NP-11929
SCDC-		
2626	16-25509	See TID-16274
SCL-T-		
423	16-25278	Dep.(mc); $1.10(fs), $0.80(mf) JCL
424	16-25184	Dep.(mc); $1.60(fs), $0.80(mf) JCL
434	16-25769	Dep.(mc); $1.60(fs), $0.80(mf) JCL
SCNC-	**(Misc.)**	
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62	16-25420	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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35(p.97-100)	16-26203	See AEC-tr-5145
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14960	16-25655	Dep.(mc); $2.60(fs), $1.04(mf) OTS
15144	16-25681	Dep.; $2.50(OTS)
15225	16-25618	Dep.(mc); $3.60(fs), $1.22(mf) OTS
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